A

MATHEMATICAL
COMPENDIUM;
OR,

Useful Practices
IN

Arithmetick, Geometry, and A-
stronomy, Geography and Navigation,
Embattelling, and Quartering of Armies,
Fortification and Gunnery, Gauging and
Dyalling.

Explaining the Logarithms, with
new Indices ; *Nepair's* Rods or Bones ;
making of Movements, and the Applica-
tion of Pendulums ; with the projection
of the Sphere for an Universal Dyal, *&c.*

By Sir *Jonas Moore*, Kn.ᵗ Late Sur-
veyor General of his Majesty's
Ord'nance.

The Second Edition, with many large Additions.

To the Truly Honoura-
ble *George Legg*, Esq; Go-
vernour of his Majesty's
Town and Garrison of
Portsmouth, Lieutenant
General of his Majesty's
Ord'nance, and Master
of the Horse to his Royal
Highness the Duke of
York, &c.

Honour'd Sir,

IT is now the second time
that this Compendium
appears abroad in the
world, & though the modesty of
the learned Author suffered it at

A 2   first

first to peep out under a borrowed Name, yet the accurate and succinct method of handling so useful a subject, speaks the Treatise to be (what I know it was) the work of that ingenious and expert Mathematician, Sir *Jonas Moor*, Kt. None have a Title, Sir, to own, or to give *Reputation* to Books of this nature, that within a thin shell contain a large *Kirnel*, and instruct much in few words; but those who being preferred to publick charges for *Learning* and *Merit*, prefer the *Publick Good* before the

the applause of the people : And none, Sir, who know by how indefatigable Studies you have perfected your self in all the parts of Mathematicks, animating the practice of them by the most exact Theory, and confirming that Theory by the best of practise ; can doubt , but that as your extraordinary Worth hath rendred you acceptable to those who are the best Judges, and truest rewarders of merit ; so your Loyalty to your Prince, and Love to your Countrey , are far dearer to you, than any particular con-

A 3   cerns

cerns whatsoever can be. You
have had skill, Sir, to contrive,
and valour on many occasions,
to make practicable both by Sea
and Land, many great things
in Navigation, Fortification,
Art of War, Gunnery, and all
the laudable Arts that give glo-
ry to a Nation; but the parti-
culars you have atchieved there-
in, the Publick must expect to
learn, from those inspired Pens
that shall transmit the History
of our Times to future Ages,
for I should presume above my
reach to attempt the task. I
beg therefore pardon, Sir, for

the

the boldness I take, in prefixing
your Name to this second Edi-
tion of the Book. It has been
already well received in the
world, and I am perswaded
that your innate Disposition to
encourage all endeavours that
tend to publick advantage, will
incline you to imprint on its in-
trinsical value the currant stamp
of your Patronage and Appro-
bation. As this is the best of-
fice I could perform in this pub-
lication, so is it, Sir, the only
way I could find to testifie my
Gratitude for those many un-
deserved favours, you have

A 4 been

been generously pleased to heap
so liberally upon my *Relations*
and my self, having hereby the
honour to profess to the world,
how much I am, and in all
dutifulness aspire to be,

:

Sir,

Your Honours

Most Humble,

And Faithful Servant,

Robert Harford.

The Principal Contents of this
Book, with the Page and
Number anſwering.

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The

*The Order of the Tables at the latter
end of the Book.*

1. The Table of Logarithms for all numbers under 100000.

2. The Table of Proportional Parts.

3. The Table of Sines and Tangents to each degree and minute.

4. A most excellent Table of the Stars that come under the North Pole, and their right Ascensions. *Lat.* 51°. 32'.

5. A Table of the right ascension of the ☉ in time.

6. A Table of the Longitude and Latitude of 100 notable fixed Stars, with their right ascension in degrees and time, and Declination for the year 1680; with the difference for every 10 years, to supply them for ever.

7. A Table of the Prices of Commodities, from 1 to 10000;
Pounds,

Pounds, Ells, Yards, &c.

8. A Table comparing the English Foot and Pound, with foreign Feet and Pounds.

9. A Table for Gaging Casks not full.

10. A Table of meridional Miles and Parts.

This

This Note for the ready taking the height of the Pole, by the height of the Pole-Star, should have ended the Book, but wanting room I place it here: Consider the 28 Fig. where P is the North Pole, ZPN the Meridian, the Circle ZdNb, the Circle the Pole ✳ makes about the Pole, Z the Pole ✳ above, N under the Pole, d the Pole-star in any Quarter of the Circle, PZ or PN is the Radius = this year 1674 to 2°. 25′. 59″, or 8759″, and for every year to come subtracting 20″ it will be 1675 = 8739. 1676 = 8719, &c. Next thing to know, is the Right Ascension of the Pole ✳, which this year will be 9°. 12′. 46″ at Z, and every year adding 1′. 54″ to the former, makes it to be 1675 = 9°. 14′. 40″, 1676 = 9°. 16′. 34″, &c. which must be turned into time, allowing every degree 4′, &c. Subtract the ☉ Right Ascension from the Pole ✳ Right Ascension, leaves the time of the Pole ✳ Right Ascension at Z above the Pole, and adding 12 hours at N under.

Now by a true Pendulum Watch, at any time when you would find the Latitude having the time of the Night, take the Diff. betwixt the Pole ✳ Right Ascension at Z, and that time, and turning that into deg. '&", it shews in what part of the Circle the Pole ✳ is, and in what Quadrant, and the L at P. Lastly, add the Logarithms of the Cosine of

dB o,

d B o, _and_ d B, _or_ P z, _and_ ſubſtract Rad.
it gives the Log. _of_ Po. _Now the height of
the Pole_ ✱ _leſs or more_ Po. = _height of the
Pole._

_Modern Fortiſications ; or
Elements of Military Archi-
tecture : By_ Sir Jonas Moore.
Illuſtrated with ſeveral Figures.

Decimal

Decimall Tables

Perch:	Decim:	Averd:	Decim:	Monne:	50 Averd	Troy:	0 Monne:	Troy:	
	5		10 60	7	9	11	1	1	1
10					12			2	2
		10		8	10 13	12	2	3	3
	10		20 70		11 14		3	4	4
20				9 12	15	3	4	5	5
	15		30 80		13 16		5	6	7
		20		10	17	4	5	7	8
30			40 90	14	18		6	8	9
	20			11	19	5	7	9	10
				15					11
40	25		50	12 16	20	6	8	10	

CHAP. I.

Of a perpetual KALENDAR,
OR
ALMANACK.

The Uses of three small *Tables* for finding the Days of the Month, Sun's place, Right Ascention, the Prime, Epact, Moon, Tides, Stars, &c. for Ever.

The first Table or Figure.
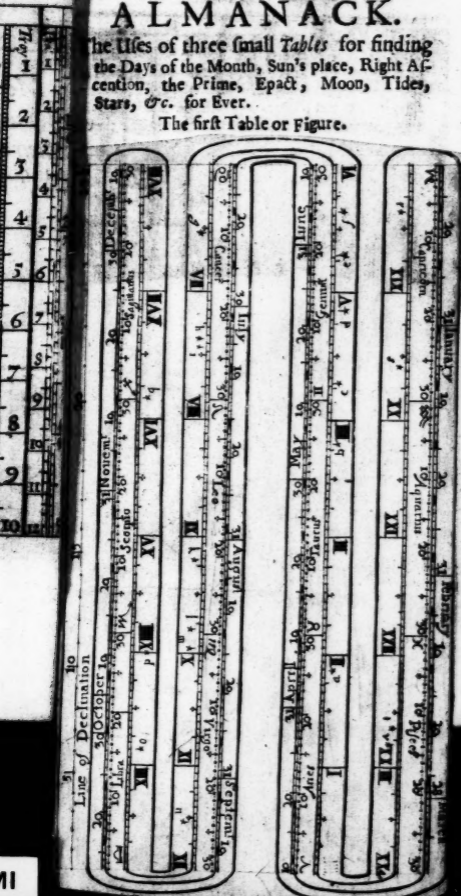
This Table begins the first of *January*, and contains the days of the Year ; the first of *January* is made black, and so every seventh until the years end ; there runs along in another Line the place of the Sun answering and opposite to the Days, (*viz.*) every degree of the Ecliptick from ♈ to ♓ through the whole Ecliptick, and near to this last Line, there runs a line expressing the right Ascension of the ☉ or Star answering unto 24 hours, each hour is divided into 15 parts, which are four minutes a piece ; next it are placed small Asterisms with Letters by them for 20 of the principal Stars set down in the Third Table.

The Second Table or Figure.

This Table, Entituled an Almanack for 140 Years, has in the middle Dominical Letters, all the seven backward from A to B, above which are years past, and below years to come, with the Prime or Golden Number under the Years, and the Cycle of the Sun below : these years are express by two Figures, and sometimes by one, and are all the Leap-years that are betwixt the Year 1600 and 1740, by explaining the lower row you will easily perceive all. In one Line there is 1660 begins, 1672, 1656, 1668, 1680, 1664, and 1676, follow, all which are Leap-years, and has to each Year the Dominical Letter above and Prime below, and those intermediate Years that are not Leap-years are to be supplied. Suppose I begin at 1660 which hath G for Dom. Letter, and Prime 8 ; for 1661 it will have F for Dom. Let. and 9 for Prime, and is supposed to stand in the room of (72) For 1662 instead of (36) 1663 instead of (68) 1664 instead of (80) and then 1664 ; so that

Leap

An ALMANACK for 140 yea'rs

Ian:
Circumcis: 1
Epiphanie 6
Hil:Ter:fe:23
Car:I.Mart 30

Feb:
Puri:Mary 2
*Shro:Tuisd:
Hil:Ter:en:13
Valentine 14
S'Mathia 24

Mar:
Daniel Ark: 5
*Esti: ⊙ day 21
Lady day 25

Apr:
*S'George: 23

May:
S'Phil.&Iac 1
*Easi:Ter:en
*Whit: ⊙ day 9
*Trinity:Te:fe: 21

Iun:
*Trinity:Ten 9
S'John Bap: 24
S'Peter Ap: 29

Iul:
S'James ap:25

Aug:
Lamas 1

Sep:
S'Barthol: 24
Ex: ♉: 14
S'Mathew 21
S'Michael 29

Oct:
S'Luke 18
Mich:Ter: 23
Simō &Iud 28

Nou:
All Saints 1
Mich:Ten: 28
S'Andrew 30

Dec:
S'Thomas 21
Nat Christ 25

Veers party							Lick	Veers to come						
4	16	600	12	24	8	20	G	60	72	56	68	80	64	76
9	2	5	17	10	13	6	F	88	1	4	16	9	12	5
18	11	14	7	19	3	15	E	700	84	96	8	92	4	
							D	17	10	13	6	18	2	14
							C	16	28	12	24	36	20	32
							B	7	19	3	15	7	11	4
							A	C ⊙ 17	1	13	25	9	21	5

A 2

Leap.

(4)

Leap-year is twice accounted, one for that part of the Year, from the beginning of *January*, to the end of *February*; the latter for the other part of the Year, and has two Dom. Letters. Further, 1672 is in the Table, but this present Year 1674 is not there, but imagined to stand in the place of 1668, and has D for the Dom. Letter, and 3 for the Prime, accounting from the last Leap-year 1. On either side of the last Oblong are the Months in order, with the Festivals, Terms, and Notable Days in each Month, when they fall upon. The moveable Feasts are marked with a small star, as in *February* Shrove-Tuesday, and in *March* Easter-Sunday, and have a day set to them, to which every Year another number being added makes them certain.

The Third Table or Figure.

This Table has on the left hand in four small Columns, (1) The Prime expressed by Points and Figures down to 19; (2) The Epact answering to the Prime; (3) The Dominical Letter; (4) A number answering, which serves for ascertaining the Moveable Feasts. Next the former are the Names and Declinations of twenty principal fixed Stars, with the Letters of the Alphabet, to direct where these Stars are to be found in the 1 Table for their right Ascensions, and the fourth Column shews whether their Declinations be North or South. The last thing in this Table observable, is, the New Moons or Changes it has 13 Columns; the first are the Year of the Lord, every Tenth Year expressed from the 0 which signifies 1600, and so you will find all the figures that stand right, which are 1, 2, 3, 4, 5, 6, 7, 8, 9. stand for 1610, 1620, &c. Then △ stands for 1700, and so the Figures stand down.

(5)

downwards till 1790, which is for 200 years
the intermediate years to be supplied as was
done in the Second Figure, for the Years betwixt
Leap-years.

The Days Eq. Dō DL NoⅭ	The Names and Decli of fixed Stars	The ☽ motion and Declin		The ☽ change

The Columns under the 12 Months express the day of the mean Change of the ☽ every month, if the Figure stand right; that is, with its head up it stands singly for so much, if it stand with its head to the right hand it signifies 10, and so many days besides; if towards the left hand, then 20 and above; if downwards, then 30 and above.

The particular use of the three Tables aforesaid.

Use 1. To find the Prime, Dom. Let. and Cycle of the ⊙ for any year proposed.

Example, 1674 I find in Table 2 among the years 72 last Leap-year, I tell on 1673, 74, where (68) stands, D is the Dominical Letter, 3 the Golden Number (by accounting from one under (72,) and 3 the ⊙ Cycle. Again, if 1676 were proposed, G and A the Dom. Let. 5 the Prime, and 5 ⊙ Cycle.

2. To find the Epact, in the third Table under the title of Epacts against the Prime, as against 3 the Prime, the Epact is 3, against 5 Epact 25.

3. To find what Day the Year begins on, because A is always the first of *January,* if that be the Dominical Letter, then it is Sunday; if any other, as in the Year 1674 D, tell back to A, as D Sunday, C Saturday, B Friday, A Thursday: All the black days in (Table 1) are Thursdays that year; and having the Thursdays, the rest are had: And thus you may find whether any Lease or Bond be right dated, and what day of the Week any day will fall on that is to come.

4. (Table 1) against the day of the week you may find the place of the ⊙, and the right Ascension; as against the 25th of *March,* the 15 degree of *Aries* stands, and the right Ascension 1 h. and 8.

5. The (2 Table) amongst the Months shews the

the Festivals and Terms, if they be fixt; but for the Moveable that have a Star adjoyned, you must find how many days must be added each year to them to make them fixt; suppose 1674, 3 is the Prime, and D the Dom. Let. against 3 the Prime in the (3 Table) you have E the Dom. Let. and 23 a number, now tell how far distant E is from D forwards, viz. 6, which 6 added to 23, makes 29 to be added to the number against all the Moveable Feasts, to make them fixt for this year; viz. Shrove tuesday being found on the second of February, add 29 makes it the third of March, and Easter day the 19th of April.

6. For the twenty Stars, if any of these named come into the Meridian, or to any known hour of the night, find the Star in the (3 Table) and observe the Letter that answers; seek that Letter in the first Table, and find what right Ascension it hath; take the Sun's right Ascension from it (but if it be less, add 24 hours) and the difference in time added to the Star's hour gives the true time of the night.

7. To find what day the Moon changeth each Month; as in the year 1673, look in the (3 Table) against 7 account 1670, tell down, 71, 72, 73, (that is, where E stands downwards) it changeth in January the 8th day, in February 7, March 8, &c. (this is meant of the mean Change) If when you have got the day of the Change you place that in the Kalendar (Table 1) you may find the Moon's age any day.

8. To find the time of high water at London-Bridge, you must very well observe the Column for the Moons Motion and Tides in Table 3, where first you have small figures going down to 15 in one line, and from 16 to 30 in another, being the Moon's Age for the Tides, which are had by inspection in the two annext Lines divided into hours and fifth parts, and marked with the

Nu-

Numerical Letters, (the small figures intermixt being for the time of the Moon's shining.) As for Example, ☽ 8 days old, it is high water at 9 h. and 24 minutes, at 22 days old at 8 h. and 36'.

9. To find the length of the Moons shining. Here the Age of the Moon is accounted down in the first Column to 15, and up again to 30 in the same, and the time is expressed by the small Figures amongst the Numeral. As at 8 days old the shining is 6 h. and 24', at 24 days 4 h. 48'.

10. For the Moon's Rising and Setting take this Rule.

Increas. $\begin{cases} \begin{cases} \odot \text{ rising more } \text{☽ shining} = \text{☽ rising.} \\ \odot \text{ setting more } \text{☽ shining} = \text{☽ sett.} \end{cases} \\ \end{cases}$
Decreas. $\begin{cases} \odot \text{ rising less } \text{☽ shining} = \text{☽ rising} \\ \odot \text{ setting less } \text{☽ shining} = \text{setting.} \end{cases}$

11. To find the time of the night by the Moons shining on any Dyal; first, the Tides are three hours more than the ☽ Southing otherwise.

☽ Southing less by the shadowed hour =
   Time in the East.
☽ Southing more the shadowed hour =
   Time in the West.

12. These proportions are all near true, but not absolute, because they respect only the mean Motion, having not regard to the ☽ Latitude. Without this Book may be had all the three Tables printed together to use alone.

CHAP.

CHAP. II.

Of Weights and Measures, Of Mettals, Water, &c. and other useful Notions.

1. *Measures of Application or Length are denominated from the parts of the Body, but are indeed in England taken from the Yard-Standard kept in Guild-Hall; the third part is a Foot, and the 36 part an Inch; expressed in this Table from an inch to a Mile.*

Table of Long Measures

Inch	Palm	Span	Foot	Cubitt	Yard	Ell	Pace	Fedom	Poole	Furlong	Mile
inch.											
3	Palm.										
9	3	Span.									
12	4	1⅓	Foot.								
18	6	2	1½	Cubitt							
36	12	4	3	2	Yard.						
45	15	5	3¾	2½	1¼	Ell.					
60	20	6⅔	5	3⅓	1⅔	1⅓	Pace.				
72	24	8	6	4	2	1⅗	1⅕	Fedom.			
198	66	22	16½	11	5½	4⅖	3⅓	2¾	Poole.		
7920	2640	880	660	440	220	176	132	110	40	Furlong.	
63360	21120	7040	5280	3520	1760	1408	1056	880	320	8	Mile.

Table of Square Measures

Acre	Rood	Pole	Pearc	Yard	Feet	Inch
Acre.	4	160	1742⅖	4840	43560	
	Rood.	40	435⅗	1210	10890	
		Pole.	10 89/100	30¼	272¼	39204
			Pearc.	2 7/9	25	3600
				Yard.	9	1296
					Feet.	144
						Inch.

Turn the side to you, and then this Table of long Measures, (as all the rest after) may be considered as to the Columns or Spaces betwixt line and line from top to bottom : or linear, or by lines from the left to the right. The Column is of the same name as at the top ; suppose inches, 3, 9, 12, 18, &c. are all inches : But in the line do severally belong to the name at the end of the line ; as 36 Inches, 12 Palms, 4 Spans, 3 Feet, 2 Cubits make severally a Yard.

Square Measures or Superficial are contained in the other Part ; as, One Pole square are 10,89 square paces, 30$\frac{1}{4}$ square yards, 272$\frac{1}{4}$ square feet, 39204 square inches. In the Table of long Measure it is said a Pole or Perch is 10$\frac{1}{2}$ feet which is the Statute Perch ; besides which there are other customary Perches or Poles, viz. 18 Feet for Fens and Wood-land, 21 for Forests, *Lancashire* and *Irish* Measure, and 18$\frac{3}{4}$ *Scotch*.

The Measure for Horses is by the handful= 4 Inches.

How these Measures of ours agree with others abroad ; see a Table printed in Modern Fortifications ; and at the later end of this Book.

The Ell is five quarters of a Yard, and has 20 Neyles ; as a Yard has 16 ; $\frac{1}{5}$ of an Ell=$\frac{1}{4}$ of a Yard. A *Dutch* Ell or stick is Three Quarters of a Yard by which Tapestry is measured.

2. Before we come to Measures of Application, which depend much upon Weights, we will treat of Troy and Averdupois weight : By Troy weight, Gold, Silver, Jewels, Amber, Electuaries, Bread-Corn, Liquors, are weighed, and from this Troy Pound are taken all Measures for Wet and Dry Commodities.

Averdupois weight weighs all manner of things that

that can waste, and though the Pound Averdup. be greater than the Pound Troy, yet the Ounce is lef. The Pound Troy is divided into Ounces, Peny-weights, Grains, &c. and the ℔ Averd. into Ounces ℥, Drams Ʒ, Scruples Ə, Grains Gr. The Tables follow.

Troy Weight.				Apoth. Weight.					
				Gr.					
Grains:				20	Ə				
24	Pen.wt			60	3	Ʒ			
480	20	Oun.		480	24	8	℥		
5760	240	12	℔	5760	288	96	12	℔	

Apothecaries make up their Medicines by the laſt Table of Troy weight, but buy and ſell Druggs by the Averd.

Scruples		Averd. Weight.				
3	Drams					
24	8	Ounc.				
384	128	16	pound			
43008	14336	1792	112	Hund.		
860160	286720	35843	2240	20	Tun	

The great Hundred is always 112 l. and 20 of theſe makes a Tun. Eighty Ounces Averd. make near 73 Ounces Troy; which is 5 l. Averd. to 6 l. Trov, which ſhews the Ounces Averd. leſſer, and the l. Averd. greater than the Ounces or l. Troy.

Dr. *Wiberd* who was very diligent makes 14 l. Averd. equal to 17 l. Troy; therefore let this proportion hold; } Troy l. to Averd.l.17.14.
{ Troy ou.to Av.ou. 51.56.
And

And by very good Experiments of him and others, it will be very useful to know that one Ounce of pure running or rain water Troy will fill 1,3949 inch and 1 oun. Averd. 1,72556 inch. one l. Troy will fill 22,7368 solid inches, and 1 l. Averd. 27,609; one solid foot will hold 76 l. Troy, and 62,588 Averd.

A Tun weight Averd. is always 20 C. of all things, except Lead, which is 19 C. and a half. Allum, Cinnamon, Nutmegs, Pepper and Sugar has 13½ l. to the Stone, and 108 l. to the C. *Essex* Cheese or Butter the Clove is 8 l. the Wey 32 Cloves, or 256 l. In *Suffolk* the Clove is 8 l. the Wey 42 Cloves, or 336 l. Hay should have 20 C. but is sold for 18 C. 36 Trusses, or 2016 l. Wooll is sold by the Clove, or half Stone 7 l. by the Stone 14 l. Tod 28 l. Weigh 182 l. Sack 364 l. Last 4368 l. Iron and Shot are weighed 14 l. to the Stone, 28 l. to the Quarter, 112 l. to the C. 20 C. to the Tun. A Fagot of Steel is 120 l; a Burden of Gad Steel is 9 score, or 180 l. For the weight of Butter and Sope 56 l. of Butter, and 60 l. of Sope make a Firkin, and four Firkins a Barrel of either.

3. *Dry Measures* of Capacity, are raised from the Gallon, containing 8 pints, which should be contained in 272¼ Cubick Inches, and should hold of pure running or rain water 9 l. 13 ounc. 12 dr. ½ of Averd weight. Therefore to come to a true Gallon for dry measure, if you make a square Vessel that shall have each side 6 inches, and 48 hundred parts of an inch, or if you weigh with Averd. weights, 9l, 13 oun. and 12 drams of clean rain or running water, either of these will find out a Gallon Dry Measure.

Pints

Corn measure.

Pints	Gal	Pec	Bush	Carnock or coomb	Seam rafer or quart	Wey	Last
8							
16	Gal						
64	2	Pec					
128	16	8	2 strik				
256	32	16	4	2			
512	64	32	8	4	2		
3072	384	192	48	24	12	6	Wey
5129	640	320	80	40	20	10	10 Last
A 1.	8½	17	68	136	:75	542	3072 5120
B 1/40	7l.	14	56	1 C.	2 C.	4 C.	24C. 40C.

The Number in the Line A expresseth in pounds
Troy the weight of Wheat in all the Measures, in
B. Averd. weight.

Meal is weighed as Corn, but the common
repute is, that a Gallon of wheaten Meal weighs
7 l. Averd. and 8 l. 6 ou. 4 d. weight Troy; and
so a Bushel 56 l. Averd. and 68 l. 1 ou. 12 d.
weight Troy. All other Grain; likewise
Salt, Lime, Coles, &c. follow this measure,
which is called *Winchester* measure: But note,
that as Sea-Cole and Salt are measured with this
Bushel, then they are heaped, or else there is
allowed five striked Pecks to the Bushel; and
this is called Water-measure; 36 such Bushels
are a Chaldron of Coles; and on ship-board they
allow 21 Chaldron to the Score.

4. Liquid measure, is either Wine, or Ale and
Beer measure. The Gallon for Wine Measure
contains 231 Cubical inches, and should hold of
pure rain or running water, 8 l. 1 oun. 11 dr.

Averd.

Averd. and 9 l. 10 oun. 1¼ d. Troy: Therefore to get a true Wine Gallon, make a square Vessel that shall have all the squares and depth 6 inches and 13 hundred parts of an inch, or if you weigh with Averd. weights 8 l. 1 oun. 11 dr. of pure running water; either of these will find out a true Gallon of Wine measure.

A Table for Wine measure.
A Tun of Wine weighing Averd 17 C. weight.
One Pint 1. 0½ ounces Troy.

	Gall.	Rund	Bat	Terce	Hogf.	Punsion	But	Tun
Pints	8	144	252	336	504	672	1008	2016
Gall.		18	31½	42	63	84	126	252
Rund			1¾	2⅓	3½	4⅔	7	14
Bat				1⅓	2	2⅔	4	8
Terce					1½	2	3	6
Hogf.						1⅓	2	4
Punsion							1½	3
But								2

The same For Honey, Oyl, &c.

5. The Gallon for Ale or Beer holds 282 solid inches, and weighs of pure water 10 l. 3 ou. |426. Therefore the square Vessel ought to be 6 inches, and 55 hundred parts of an inch each way, and the water 10 l. 3 oun. |42 Averd. to find this Gallon.

A Table

A Table for Beer.

Pints					
8	Gall.				
72	9	Firk.			
144	18	2	Kild.		
288	36	4	2	Barrel	
576	72	8	4	2	Hog.

Ale.

Pints					
8	Gall.				
64	8	Firk.			
128	16	2	Kild.		
256	32	4	2	Barrel	
512	64	8	4	2	Hog.

Note that vessels for Butter, Fish, Sope, follow
the Ale measure of a Gallon; 8 Gallons makes
a Firkin, 2 Firkins a Kilderkin, 2 Kilderkins an
Ale Barrel, and 12 Ale Barrels a Last.

6. Tale and number of several goods.

Of Canvas cloth, the C. is 120 Ells; of Fusti-
on 1 Chef is 14 Ells; of fine Linnen, Silk, and
Syndon 10 Ells.

Codfish, Haberdine, Ling, &c. has 124 to the
C. and 1240 the M. Eels 25 to the strike, and
10 strike to the Bind. Of Herring 120 to the
C 12 C to the M. laid in a Barrel, and 12 Bar-
rels to a Last.

Tale of Furrs, Filches, Grayes, Jennets, Mar-
tins, Mincks, Sables, 40 skins is a timber: other
skins 5 score to the C.

B 3   A Seam

A Seam of Glass is 24 stone, or 120 l.

One Bale of Paper is 10 Ream, a Ream 20 Quire, a Quire 25 Sheets.

One Rowl of Parchment is 5 dozen, a dozen 12 Skins.

Ten Hides are a Dicker, a Last 20 Dickers.

Ten pair of Gloves a Dicker; and so 10 Horse-shooes.

Tale of Fuel. All Billets should be 3 foot long, and so all Faggots; and the band beside the k: or 24 inches round, and not flat.

A Last of Powder is 24 Barrels or Firkins, which must hold 100 l. neat.

Timber is sold either by the Tun or Load; a Tun is 40 feet, a Load 50 feet solid.

7. Of Gold and Silver. They are near the proportion of 13 to 1; therefore if an Hebrew Talent of Silver be valued at 375 l. that of Gold will be 4500 l.

The value of Gold here in *England* is as follows. One penny weight of Angel-Gold is worth 4 s. 2 d. ob. of Crown Gold 3 s. 10 d. ob. of Sovereign 3 s. 6 d. ob.

One pound sterling money ought to have 11 ounces 2 penny weight fine Silver, and 18 p. weight Allay.

Fineness of Gold is esteemed by the Karrach no certain weight, but the $\frac{1}{24}$ of any quantity: thi Karract is divided into grains and parts.

The Karract that weighs Jewels, is divided into 4 gr. of which grains 20 make 24 gr. Troy, or 1 pen. weight.

8. Metals, Stone, Liquors, Grain, &c. are compared as in the Table following; where there are 4 Columns; the first Column A has their names of them; the second Column A has their weights in Troy ounces answering to a Cubick inch of Magnitude; the third Column B has their magnitude in inches and Decimal parts, an-

swering

fvering to one Oun. of weight Troy; the third Column C is the weight of a Cubick inch in the water, in Troy ounces and Decimal parts.

	Ou. A.	inch. B.	C
☉ Gold ----	9.91735	0.10083	9.33962
☿ Quickfilver----	7.93388	0.11604	7.35015
♄ Lead ------	6.16198	0.16229	5.58425
☽ Silver ------	5.50083	0.18179	4.92310
♀ Copper ------	4.81342	0.20776	4.23569
♂ Hammer'd Iron	4.27715	0.233°0	3.69942
Caſt Iron ------	3.96821	0.25253	3.29048
♃ Tin-------	3.96694	0.25208	3.38921
Marble ------	1.59631	0.62644	1.01858
Common ſtone -	1.09835	0.91045	0.52062
Honey ------	0.79339	1.16042	0.21365
Salt water----	0.57773	1.79490	2.00000
Freſh wat. or wine	0.52773	1.77190	
Oyl ------	0.47603	2.10069	
Wheat-----	0.37628	2.65717	
Dried Oak -----	0.40745	2.45609	

The uſes of theſe Tables will appear hereafter in the Rules of Practice.

Troy wt. 1 l.fo:er. Gold } is wor h { 42 10
Averd.wt.fover. Gold } is wor h { 51 14 ¾

So that 100 l.in Crown gold weighs only 1 l. 12 ou. and 100 l. in filv. mony will weigh 26 l. 9 ou. Av.

You may find by the former Rule and Table, that one cannot well be cheated by the bulk of gold and other metals, by reaſon of the weights.

To end this Chap. I have added the Aſſize of Bread in Averd. weight; a very uſeful Table to correct Bakers; the Town Bakers prizes being on one ſide Foreigners on the other; the Table in it ſelf will be information ſufficient. The Officers in towns, and Juſtices of Peace in the country ought to obſerve theſe Rules: On the right ſide and left there is ſet down the price of a buſhel of Wheat, and if the Bakers want one ounce in 36, to ſuffer the Pillory.

B 3   Thee

The Assize for Bread for all
WEIGHTS.

Weight of a Penny Loaf.

Free Town Bakers		Troy			Averd.			Foreigners
s d	white	wh.	hou.	white	wh.	hou.	h.
2 0	16 13	25 4	33 11	15 7	23 1	30	15 2
2 3	15 17	25 3	30 14	14 2	21 3	28	4 2
2 6	14 4	21 6	28 8	13 0	19 10	26	0 1
2 9	13 3	19 13	26 7	12 1	18 2	24	3 3
2 0	12 5	18 8	24 11	11 5	16 18	22	11 3
3 3	11 9	17 6	23 3	10 1	15 17	21	3 6
3 6	10 14	16 5	21 13	9 19	14 18	19	18 9
3 9	10 5	15 7	20 9	8 18	14 2	18	16 0
4 0	9 12	14 10	19 8	8 18	3 7	17	16 3
4 3	9 4	13 14	18 8	8 9	12 13	16	18 6
4 6	8 13	13 4	17 10	8 1	12 1	16	24 9
4 9	8 7	12 10	16 14	7 13	11 13	15	7 0
5 0	8 1	12 1	16 2	7 7	11 0	14	14 3
5 3	7 11	11 9	15 7	7 1	10 11	14	2 6
5 6	7 6	11 2	14 13	6 15	10 3	13	10 6
5 9	7 2	10 11	14 4	6 10	9 15	13	0 6
6 0	6 14	10 4	13 11	6 5	8 12	10	6 3
6 3	6 10	9 15	13 4	6 0	9 1	12	1 6
6 6	6 6	9 9	12 12	5 16	8 15	11	13 6
6 9	6 3	9 4	12 6	5 12	8 9	11	57 0
7 0	5 15	8 15	11 15	5 9	8 10	10	18 3
7 3	5 12	8 11	11 9	5 7	18 10	11	7 6
7 6	5 9	8 8	11 3	5 7	13 10	10	57 9
7 9	5 7	8 3	10 14	5 4	19 7	9 9	19 8 0
8 0	5 4	7 15	10 9	4 16	7 5	9	12 8 3
8 3	5 2	7 12	10 5	4 14	7 1	9	8 8 6
8 6	5 0	7 8	10 0	4 11	6 17	9	2 8 9
8 9	4 14	7 5	9 12	4 9	6 13	8	18 9 0
9 0	4 13	7 2	9 8	4 6	6 10	8	13 9 3

CHAP. III.

OF

ARITHMETICK

And its PARTS;

And of the moſt eaſie performance of Multiplication, Diviſion and Extraction of the Roots by *Nepayre's* Rods : The uſe of the Table of Logarithms herewith Printed : Decimal Tables, Progreſſion and Proportions.

§ 1. Of the ſix Principal Parts ; Numeration, Addition, Subſtraction, Multiplication, Diviſion and Extraction of the Roots ; but firſt notice muſt be taken of theſe few Characters.

✛ Addition or more	Diviſ.) Divid. (Quot.
— Subſtraction or leſs	
X Multiplied by	Z Summ
= Equal to	X difference.

1. Numeration gives the value we place upon the 9 Digits ; the firſt place is of ſimple Unity towards the right hand, next Hundreds, next Thouſands, &c. And ſo each place ten times more to the left hand ; as you may ſee by the value of this number ; 75, 832 which is 75 thouſand 832.

And as this increaſeth towards the left hand, in a Decuple proportion, ſo may all parts or fractions of any whole thing decreaſe from Unity in the ſame proportion towards the left ; as that after Unity to be Unity into 10 parts, the next into 100 parts, &c. and though we in *England* do

do not divide our money, or meafures into thefe parts, yet to make Arithmetick eafie, we turn out accounts into it : And for the better underſtanding hereof, take notice that at *Rome* their money conſiſts in Ducats, Julios, Baioccas : Ducats is their Integer or whole Unite ; ten Julios makes a Ducat, and ten Baioccas a Julio : So that to expreſs 35 Ducats, 8 Julios, and 7 Baioccas, they ſet them thus ; 35, 87 that in reſpect of Julios it is $\frac{8}{10}$ of Baioccas $\frac{7}{100}$ parts of a Ducat; This is the true Decimal Arithmetick or Natural : But to break into other parts is inartificial, as $\frac{2}{3}$ imagines the whole divided into 3 parts.

2. Addition whether whole or parts takes the general Summ, and Subſtraction the diffe-

Ex.

357,28
92,7
215,89
2781,51
(2) 357,38

rence ; keeping certain , that Unite be kept under Unite : Suppoſe the Ex. here Ducats, Ju. and Ba. the ſumm would be 3547 Ducats, 3 Julios, and 8 Baioccas.

Ex. From 562 Ducats, 8 Jul. and 4 Ba. take 3 81 Duc. 2 Jul and 7 Baioc.

After Subſtraction there remains 181 Duc. 5 Jul. and 7 Bai.

Ex.

562,84
381,,7
181,57

Of theſe Parts no more: If any Gentlemen or other, eſpecially Ladies, that deſire to look into their diſburſements, or layings out, and yet have not time to practiſe in numbers, they may from Mr. *Humphrey Adamſon* dwelling near *Turn-ſtile* in *Holbourn*, have thoſe incomparable Inſtruments, that will ſhew them to play Addition and Subſtraction in l. s. d. and whole Numbers, without Pen, Ink, or help of Memory ; which were the invention of that worthy Perſon, and Ornament of his Country, Sir *Samuel Moreland* Baronet.

3. Mul-

3. Multiplication by memory is fit for those that have constant practice, but for certainty and ease no invention ever came near that of the Lord *Nepair* by Rods, made either of Wood or Ivory. Sir *Samuel Moreland* has devised a neat way upon Circles, but vastly chargeable, and that has been the reason why they have not been so well known. I have at last clothed sticks with Papers printed, and at very easie charge they are to be had ready varnished, better for use than made of Silver, and sold with this Book as one, with one or more papers ready to be pasted upon sticks, if the Box should be lost, and cannot be false.

To double or treble a number will be found ready by any one, as to double 7584, say twice 4 is 8, twice 8 is 16, setting down 6, and bearing one in mind; twice 5 is 10, and 1 I carried is 11, setting down 1 and carrying 1 a twice 7 is 14, and 1 is 15, all which is 15168. the same for multipl,ing by 3.

Before I come to the use of the Rods, it will be very fit to shew how Multiplication may be wrought by making a Table of the Multiplicand to 9 as follows: Suppose I would multiply 6831 by 693, I take the Multiplicand 6831, and making a line before it, I set down the Digits to nine, I double it and set it against 2, I add the first and second for 3, 1 double that against 2 for 4, add the second and third for 5, double the 3 for 6, add the third and fourth for 7, double the fourth for 8, and add the fourth and fifth for 9; see the Table.

Table X.

Table X.		
1	6831	6831 Multiplic.
2	13662	693 Multiplier.
3	20493	———
4	27324	20493
5	34155	61479
6	40986	40986
7	47817	———
8	54648	4733883 Prodñt.
9	61479	

Now set dow
the Multiplica
and Multiplier
and set in the T
ble the number
gainst 3, and set
down against 9
and set it one pla
to the right han
against 6, and 6
still one place fu

ther, as in the Ex. whereby adding all the thre
Multiplees you have the General Produ
4733883. You may try with lesser numbers, a
perfect this way in an hours time.

The Rods being set together makes this Tabl
at one work for present view.

First then having the Box open, you are f
the first sight to know what figures stand o
each side of the Rod; that next to you is fa
that under it, or the side the Rod lies on, is th
complement to 9, and the figures on both sid
of the Rod are seen at the bottom by two sma
figures under the black Line: Suppose you fi
the Rod 6 upwards, you will know 3. the r
mains to 9 is under, and at the bottom you wi
see 1 on one side and 8 on the other; so at on
glance you have four figures, know 6, 3, 8,
and this is proper to each Rod, and must be pe
fectly learnt. From hence you may find, that
Rods have all the Digits four times over, th
is four 1, four 2, four 3. four 4. &c.

Having learnt quickly to find a Figure, th
next is to place the Multiplicand upon the Rod
suppose in the Ex. 6831, I had these 4 figure
as before, and placing 6 next the Index (fixt i
the Box) then 8, then 3 and 1; the Digits an
then Tabulated, and against every Digit in th
Index you have the very same figures as in th

Tabl

Table aforegoing, to be found with this caution, that you begin at the right hand, and taking out first the single figure that stands in a triangle, after that you must take the two figures that stand in the Rombus, if there be two, and if both be under 10 write the summ down as one figure , if above 10 write the surplusage above 10 down, and carry one to the next cell, but all will be better seen from the Rods themselves than 100 times from words : See the (first Figure) in the last page, where you will find the former number 6831 on the top, and against 2 (which is two times the number) you have in the Triangle first 2, then in the next Rombus 6, next 2 and 1, which you set down 3, last 1, which makes 13662 as in the former Table; next six times is first 8, then 8, then (8 and 1) = 9, then (6 and 4) = 0, then (3 and 1) = 4; so the whole will be 40986, and nine times will be 9, 7, (2 and 2) 4, (4 and 7) 1, (5 and 1) 6, (61479) as in the Table before; a small labour will make you read the Rods as quick as you may see them in the Table, either backward or forward.

If there be any decimal parts in the one or both Ld or Mr, tell their number of places, for there must be as many places cut off by the distinction as were in both.

Multiply 37, 5, that is 37 Duc. and 5 Jul. by 15, 91, that is 15 Duc. and 9 Jul. and 1 B. You shall have the Product 596, 625, that is 596 Duc. 6 Jul. 2 Baioccas and a half; there are 3 places cut off because there was 1 in the Multiplicand, and 2 in the Multiplier.

4. Division has no more difficulty than formerly, tabulate the Divisor on the Rods, one Example will be sufficient ; let the Dividend be 4733883, the Product in the former Example, let 6831 be the Divisor to be tabulated on the

Rods,

Rods, you have the Multiplying of it to 9 before,
which is here repeated.

		Divisor	Dividend	(Quotient
1	6831	6831)	4733883	693
2	13662		40986··	
3	20493			
4	27324		63528	
5	34155		61479	
6	40986		2·493	
7	47817		20493	
8	54648		0	
9	61479			

The Table of the Divisor stands for the Rods
first, I see that 6831 will not be in 4733, there-
fore you must go 5 places; then looking on the
Rods, or in the Table for a number that is equal
or next less to 47338, I find it to be 40986,
that is 6 times the Divisor. I set 6 in the Quo-
tient, and subtract 40986 from the figures
above, rests 6352, to which I add 8 the next fi-
gure of the Dividend, and seek again upon the
Rods or Table for it, or the next less, which I
find to be 9 times, I set 9 in the Quotient and
take 61479 plac'd as in the Example, and sub-
stract it, remains 2049, to which I add 3 the
last figure, and work as before said, 3 times car-
ries all away and nothing remains, the Quotient
being 693.

For Decimal parts there must be as many pla-
ces in the Divisor and Quotient as are in the Di-
vidend, in this Example.

15,91) 596,625 (37,5
    477 3··
    11,932
    11137
      7955
      7955
        0

In the Dividend
there are 3 places, in
the Divisor 2, there-
fore the Quot. must
have 1 decimal place,
which is 37 Ducats, &
5 Julios 5 and in case
there

there be no Decimals, or fewer in the Dividend than Divisor, put as many Cyphers as you please after the Dividend, which are decimal places, and if you find that there be defect in the Quotient, put Cyphers before it, to supply the places.

5. Extraction of the square Root has some difference, but not much, from Division. (1.) Point each other figure beginning with the last, as in the Example, 6, 5, and 7, which shews there will be 3 figures in the Root (2.) Take the Rod called the square Rod that has at the top square, and set it to the Index, and seek for the figures the first prick (57) you will find 49 nearest, set 7 in the Quotient, and substract 49 from 57, rests 8. (3) To this remainder (8) add the next two figures to the next prick (15) makes it 815. (4.) double the Quotient 7, viz. 14, and set it upon the Rods, and place those Rods betwixt the Index and square Rod, each time after the first work: Seek then upon the Rods for the next less or equal number to the figures 815, which I find to be 725, that is 5 times; setting 5 in the Quotient, substract, and to the Remainder add 2 places to the next point (36;) lastly, double the Quotient 75, which is 150, set this betwixt the Index and square Rod, and work as before, you will find the Root 756, which multiplied by it self produceth the square number 571536. If your Root be not perfect, but something remains after the last substraction ; add Cyphers to the square and proceed.

```
        571536 (756
        49    . .
        ----
     14) 815
         725
         ----
    150) 9036
         9036
```

6. Extraction of the Cube Root ; (1.) point every third figure from the last, set the Cube Rod that hath Cu. on the head, to the Index in

                                                    the

the Box, seek the next less on the Rod, which is in the Example 64, thu... is 4 times, set 4 in th... Quotient and substract... reits 27, to which add ... figures to the next poin... the summ is 27733. (2... Square the figure found in... the Quotient and tripl... it (and this must be don... each time) for a Divisor... which set betwixt the In... dex and Cube Rod, i... this Example 4 being in... the Quotient multiply i... by it self makes 16, an...

$$91733851 \ (451.$$
$$64$$
$$48) \ 27733$$
$$24125$$
$$300$$
$$27125$$
$$6075) \ 608851$$
$$607501$$
$$135$$
$$608851$$

that multiplied by 3 makes 48, which on ... Rods I place in the Box betwixt the Index an... Cube Rod for a Divisor. (3) Seek a Quotien... which will be found 5, which set down, an... the number answering 24125 place as in th... Example 3 but before you substract you mu... triple the Quotient 4, which is 12, and multipl... it by the square of the last figure 5, viz. 2... now 25 by 12 make 300, which place u... der 24125 one place forward to the left han... as in the Example 3 then add those two numbe... makes 27125, and substract it rests 608. Th... work must be repeated for each figure in th... Quotient, viz. to 608 add 851 for a Resolven... square 45 and triple it makes 6075 for a ne... Divisor, which being placed next before th... Cube Rod, shews it will be but one for the Quo... tient, which being added to 607501 which is fi... down, and tripling 45, and multipling it by... makes 135, which set one short, makes in th... whole 608851, so that nothing remains. If som... thing remain add Cyphers, 3 for a figure, and i... will give a Decimal fraction.

Thu...

Thus much with a little practise, and that the Boxes are to be had with the Book will render all General, and it would too much augment this small Volumn, to teach the use and making of Duodecimal Rods, Sexagenary for the old Astronomy, and Centesimal, all which works two figures at once.

7. *Nepaires* Rods will reach to great Numbers but for Numbers under 100000, the said worthy Lord invented a far easier way to perform Multiplication by Addition, Division by Substraction, Extraction of the square and Cube Roots by halving or trisecting, and all this by certain Numbers in a Table called *Logarithms*, Printed at the end of the Book, wherein the first page all Log. answering to all numbers under 100 are easily found, viz. the Log. of 38 is 1.579783, of 72 is 1.857232, &c. If the number consists of 3 places, that is a number under 1000, look for the number in the Table under N. and the Log. is found in the Column under o, so the Log. of 349 is .5428.5, of 893, is .950851. If the number be of 4 places and under 10000, seek the 3 first figures under N. as before; and the last figure on the top, under which in that Column lineally against the first 3 figures you have the Log. As for Example; The Log. of 3583 is .554247, finding 358 under N. against which in the Column under 3, is that Log. so the Log. of 4168 is 620224, of 9546, is .979821 : But if the number be above 10000 and under 100000, you must find it by the difference, and Table of Parts Proportionals Printed at the end of the Table of Log. thus; if the Log. of 35786 be sought, first seek the Log. of 3578. which will be 553649, and the common difference under D, 121 ; with this difference enter the Table of Parts proportional, and find 121 in the first Column under D, and

then lineally against that number, and under
the last figure of the last place of the number
75786, found at the head in the 7th Column you
will find 72, which added to the Log. of 7578,
viz. 553649 makes 553721 the Log. of 75786.

Now before we proceed to find Numbers an-
swering to Log. it will be fit to shew you what
is meant by the first figure placed to the first 100
Log. which Mr. *Briggs* called a Characteristick
or Index, which represent the distance of the
first figure of any whole number from Unity,
whose Index is a Cypher or o 5 and so the In-
dex of Tens is .1. of 100 is 2, of 1000 is 3,

and as in this Line   CM.XMM.C X V.

            5   43   210   so that
in this Number 687325 the Index of 5 is o, of
7 is 3, of 6 is 5 : But of Decimal parts it
proceeds the other way 5 as that of ten parts
is $\bar{1}$, of 100 parts is $\bar{3}$, as in this Line 3.5781,
the Index of 3 is o, of 5 is $\bar{1}$, of 8 is $\bar{3}$, of
1 is $\bar{4}$, or after the proposal of Mr. *Christo-
pher Townley* take their Complements to 10; as
instead of $\bar{1}$ take 9, of $\bar{3}$ take $\bar{7}$, of $\bar{3}$ take
7, which will make the Addition and Substra-
ction more easie and plain : if the former be used
let it be called the first, if the latter, the second
manner.

            210 $\bar{1}\bar{3}\bar{5}4\bar{3}\bar{8}$ Index the first way.
Of Indices 378.235189   Number.
            210 $3\bar{7}7\bar{8}\bar{5}4$ Index the 2d. way.

Having laid down the grounds for the In-
dices, or the first figure in each Log. the abso-
lute Log. will readily be set down, making the
first figure the Index of the first figure of the
number 5 as the Log. of 5784 first the Log. in
the Table, is 762228. the Index of the first fi-
gure of the number 5 is 3, so the absolute Log. is
3.762228.

                           N.

N.   Log.

578,4 —— 2.762228 ⎱ So that the Log. is the
57,84 —— 1.762228 ⎬ same, but the Index of
5,784 —— 0.762228 ⎭ the first figure altereth.

,5784 —— 5.762228 ⎱ In pure parts the Log.
,05784 ··· 8.762228 ⎬ is the same but the Ind.
,005784 ··· 7.762228 ⎭ altereth after the 2. way.

Now to find the number answering to a Log.
given, omitting the Index; seek the rest six
places in the Table of Log. and where you find
the summ, or nearest the numbers in the Mar-
gent N. and over that Column will make out
4 places; The Log. 3.544821 omitting the In-
dex 3, I find 544821 to answer 3506, and the
Index shews they are all Integers, the Index
shewing the first figure to be the third from
Unity 6; so the Log. 1.544821, would shew
35, 06, that is 35 Integers, and $\frac{06}{100}$ parts, and
3.544821, .3506 all Decimal parts, and
5.544821 .03506 parts. But if the Log. be not
exactly to be found, and that you desire to have
places to five figures, first, find the number to
4 places as before, with noting the common dif-
ference under D on the side, and taking the
difference betwixt the Log. given and the Log.
found in the Table, then seeking the Common
Difference in the Table of Prop. parts in that
Line find out the difference of the Log. and over
the head you have the fifth figure. Example of
this Log. 2.543612, the Log. next less is
543571 answering to 3496, the common diffe-
rence is 124, the diff. of the Log. is 41, which in
the Table of prop. parts against 124 gives 3, so
that the absolute number is 34963, and because
the Index is 2, is 34963.

C 3.   Addition

Addition of two or more Log.

If the Indices be both (or all) Integers or whole add them without any more.

If the Indices be some Integer, some parts, tha i, be unlike, if the Index upon adding, be 10 o above, cast away 10, the Remainder is the Inde of Integers, if under 10 Decimal parts.

If the Indices be both Decimal parts, and if ad ded be under 10, add 10 to the same, if just t then 0, if above 10 cast 10 away ; the Ind. thu gotten is always of Decimal parts.

2.057821	2.237242	3.397941	3.875061
3.583210	3.875062	3.875062	3.698972
3.641031	3.698971	3.173003	3.574033
	0.811275		

Substraction of Log.

If the Indices be whole, then as before.

If the Indices be either of them, or both deci mal parts, set them one over another, then if th higher be a smaller figure than the lower add 1 to it, and observe whether the higher be of great er value than the lower, if so the Remainder wil be Integers, if not decimal parts.

2.033421	3.875062	3.875062	1.235781
3.875062	2.033421	3.574031	3.572141
2.158359	7.841641	1.301031	7.665640

The Log. of a Fraction is found by substrac ing the Log. of the Denominator from the Log. of the Numerator : sometimes it is found ne cessary to multiply a Log. by 2, 3, 4, &c. which if it be an Index of parts, observe that you use the former Indices, viz. for the first part.

᠍. 5 ᠍, &c. and that in multiplying the figure next the Ind. the Tens are affirmative, and are to be deducted out of the Product of the Indices of parts.

To divide a Log. of parts, if the Index be even it is ordinary, but if uneven, then add to the Ind. so many Unites

$\overline{5}.543211$	$\overline{1}.987214$
3	5
$\overline{3}.629633$	$\overline{1}.936070$

till it may be divided, setting the Quot. down for a new Index, augmenting the next figure by so many times 10 as you added to the first.

$$3) \; \overline{5}.321412 \qquad 3) \; \overline{7}.232151$$
$$\overline{5}.440470 \qquad \overline{3}.744050$$

The Admirable uses of the Log. Table.

To multiply one number by any other.

Add the Logarithms of the Numbers, the summ is the Log. of the Product.

N.	Log.			
32...	1.505150	5,12	0.709265	32 X 32 = 1664
52...	1.716003	1,55	0.190332	& 5,12 X 1,55
1664.3.221153	7.9360	0.899597	= 7,9360.	

To divide one Number by another is to substract the Log. of the Divisor from the Log. of the Dividend.

	N.	L.	N.	L.
Dividend	7286	3.862489	,4512	$\overline{1}.654369$
Divisor	32	1.505150	,0315	$\overline{1}.498311$
Quotient	227, 8	2.357339	14,32	1.156058

To extract the square Root of any Number is to half the Log. of that N. or divide it by 2, the Quotient Log. is the L. of the Root; and to extract the Cube Root to divide it by 3.

Number.

Number 75832 —— 4.879852   4.879852

Divided by 2) 2.439926 3) 1.626614

Square Root 275,37   Cube Root is 42,327

To find a mean Proportional betwixt 2 numbers, is to add the Log. of them together, and take half;

$$
\begin{array}{r}
\text{L} \\
\text{The numbers are} \quad 9{-}0.954242 \\
16{-}1.204120 \\
\hline
\| \text{Z } 2.158362 \\
\text{The middle proportional } 12. \quad \|\tfrac{1}{2}1.079181
\end{array}
$$

To find 2, 3, 4, 5, &c. mean proportionals betwixt any two numbers, take their difference and divide it by a number more by one than the number of means desired, as if 3 means divide it by 4, &c. this Log-Quotient added to the least, finds the first mean next it, and so added to the last finds the next, &c. It is desired to have 3 mean Proportionals betwixt 4 and 64; the Log. of 4 is 0.602060, of 64 1.806180: these two added makes 1.2.4120, the $\frac{2}{4}$ is 0.301030, which added to the Log. of 4 makes 0.903090, the Log. of 8 the first mean, and again added gives 1.204120 the Log. of 16, and again the Log. of 32 which 8.16.32. are the three mean betwixt 4 and 64.

8. Of Reduction. Greater names are brought lower by Multiplication; as Pounds are brought to Farthings by multiplying a Pound by 20. 12 and 4. and back again by dividing by 4. 12. and 20. Ordinary Fractions are reduced into Decimals by multiplying the Numerator by 100 or 1000, and dividing the Product by the Denominator.

Hence are all the Fractions of mony, weight, time.

tine, &c. turned into Decimals, as follows ;
Table I. of 1 l. Integer. The half of shillings is
the decimal, as of 16 s. is |8, of 6 s. is |3, of 11
s. is |55, of 1 s. |05 ; and note in general once
for all, that ¼ of any thing is |25 ½ |5 and ¾ |75

DECIMAL TABLES.

Pence	Eng. Coyn 1 l. Int. Table I.
11	.045833
10	.041666
9	.0375
8	.033323
7	.029166
6	.025
5	.020833
4	.016666
3	.0125
2	.008233
1	.004166
f.3	.00313
2	.002083
1	.001041

Troy weigh: Int. 1 . oz.

Penny weight the same
with shill. Tab. II.

gr.	
23	.047916
22	.045833
21	.04375
20	.041666

19	.039583
18	.0375
17	.035416
16	.033333
15	.03125
14	.029166
13	.027083
12	.025
11	.0229 6
10	.020833
9	.01875
8	.016666
7	.014583
6	.0125
5	.010416
4	.008333
3	.00625
2	.004166
1	.002083

Table III. Averdup.
great weight 112 C. I.
lib.

27	.241071
26	.232142
25	.223214
24	.214285
23	.205357
22	.196428

20	.1875	quart.	
21	.178571	3	.000418
		2	.000279
19	.159642	1	.000139
18	.160714		
17	.151785	Table IV. *Averd. little*	
16	.141857	*weight In. 1 l.*	
15	.133928	oun.	
		15	.9375
14	.125	14	.875
13	.116071	13	.8125
12	.107142	12	.75
11	.098214	11	.6875
10	.089285	10	.625
9	.080357	9	.5625
8	.071428	8	.5
7	.0625	7	.4375
6	.053571	6	.375
5	.044642	5	.3125
4	.035714	4	.25
3	.026785	3	.1875
2	.017857	2	.125
1	.008928	1	.0625
oun.			
15	.008370	dr.	
14	.007812	15	.058593
13	.007254	14	.054687
12	.006696	13	.050781
11	.006138	12	.046875
		11	.042968
10	.005582	10	.039061
9	.005022		
8	.004464	9	.035156
7	.003906	8	.03125
6	.003348	7	.027343
5	.002790	6	.022437
		5	.019531
4	.002232		
3	.001674	4	.015025
2	.001116	3	.011718
1	.000558	2	.007811
		1	.003906

An...
you m... 7 d.
0291...

quarter	
3	.002929
2	.001953
1	.000976

Table V. *Measure Gallon or Quar. the Int.*

7	.875
6	.75
5	.625
4	.5
3	.375
2	.25
1	.125

quarter	
3	.09375
2	.0625
1	.03125

Table VI. *Inches in Dec. of a Foot.*

Inches	
11	.916666
10	.833333
9	.75
8	.666666
7	.583333
6	.5
5	.416666

4	.333333
3	.25
2	.166666
1	.083333

quart.	
3	.0625
2	.041666
1	.020833
$\frac{1}{2}$ quar.	.010416

Table VII. *Decimals of a Year.*

Months	
1	.083334
2	.166667
3	.25
6	.50
9	.75

Days	
1	.0027397
2	.0054795
3	.0082193
4	.0109591
5	.0136988
6	.0164386
7	.0191784
8	.0219182
9	.0246579

The uses of the Decimal Tables.

Any parts of money, weight or measure given, you may turn into Decimals, or *contra*, 3 l. 15 s. 7 d. $\frac{1}{2}$ = 3, 78124, for 15 s. = ¦75. 7 d. = ,029166, and $\frac{1}{2}$, ,00208, in all 3 l. ,78124. A-gain,

gain, 16 C. $\frac{3}{4}$ 17 l. Averd. weight = 16,9019.

If Decimals be to be turned into their nature
again, as 37 l. ,56928, first 37 l. is the Integer,
then 55 of the first 2 figures will be 11 s. and the
remainder ,0192 will be 5 d. $\frac{1}{2}$.

9. A short Specimen of Fractions for the better
remembring the Rules of

(1.) of the great Common measure. Ex. of 36) 54 (1
36 C.M.18) 36 (
54 18) 36 (2 54
15. 14
(2) Reduction 6) $\frac{3}{12}$ $\frac{7}{18}$ are $\frac{15}{36}$ and $\frac{14}{36}$
3. 2
36

12
3. Fractions of fractions $\frac{1}{4}$ of $\frac{2}{7}$ of $\frac{6}{7} = \frac{12}{84}$
84

4. Addition & substract. of fractions reduced $\frac{15}{36} + \frac{14}{36} = \frac{29}{36}$

5. Multiplicat. $\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$ (6) Divis. $\frac{4}{5} \div \frac{2}{3}$

10. Of Progressions and Combinations.

1. Geometrical progression that begins with
Unity, you may come at any term of it by mul-
tiplying the Log. of the second term by the
number of so many places, as the distance re-
quires less, 1. Ex. in a progression that is dou-
ble, having 1. and the second term 2, and you
desire the 8 term, multiply the Log. of 2 by 7
it gives you 2,10721. the Log. of 128. the 8
term.

term, and this holds if the first term be not Unity, if you take the Log. of the Ratio.

2. Combination of things may differ many ways; Two only are here considered: (1.) In the changing their position, as in ringing of bells, the other in the matter or substance; for the first set down a Series of numbers from Unity, multiply 1 by 2 shews As 2 things, can be changed 1, 2, 3, 4, 5, 6, twice: again $2 \times 3 = 6$ 2, 6, 24, 120, 720. shews three things may change 6 times, 4 may change 24, and 5 120.

For the second, suppose *a b c* be essentially different a Ternary; There are three Unites, *a, b, c.* three Binaries, *ab, bc, ac,* and one ternary *abc.* and so many Combinations there may be and no more.

Now to find out the Combinations it is easily done by the posterior Table in Mr. *Oughtreds Clavis Math.* p. (37) he calls it (*plena hæc misteriis pulcherrima Tabula*) I say the numbers set by the Species shew the Combinations desired, only one of the extreme Unites must be left out, and the obtaining those numbers is thus; set down Unity, then repeat two Unites and leave one space, and then 2 spaces, 3, 4, &c. the
Intermediate are filled by
adding the numbers on either side standing above, as
to make up the lowest row
4 + 4 = 5 standing next above on either side, 4 + 6 =
10, &c. then leaving out the Unites on the

```
                    1
                  1. 2. 1.
                 1. 3  3. 1.
               1. 4. 6. 4. 1.
             1. 5. 10. 10. 5. 1.
                    &c.
```

right hand: 1 | 1 - - - - - - - - - - - - - - - = 1
so that if the 2 | 2 + 1 - - - - - - - - - - - = 3
matter be 3, 3 | 3 + 3 + 1 - - - - - - - - - = 7
there maybe 4 | 4 + 6 + 4 + 1 - - - - - - = 15
5 Unites, 3 5 | 5 + 10 + 10 + 5 + 1 - = 31.
&c. |

D   Bina-

Binaries, and 1 Ternary, in all 7 Combination⸱

If the matter be 4, there may be 4 Unites, ⸱
Binaries, 4 Ternary, and 1 Quaternary, 15 = ⸱

11. *Of Proportion.* Direct is when more re⸱
quires more, and less less : This is called th⸱
Golden Rule, when 3 numbers are given to fin⸱
a fourth, and requires that the second and thir⸱
terms be multiplied together, and the first di⸱
vide that Product, the Quotient shews the an⸱
swer : Ex. If 5 yards of any thing cost 15⸱
what shall 45 yards cost ? An. 6 h 15 s. for se⸱
ting them down thus : 5. 15 ∴ 45. 45 X 15⸱
(75 and 5) 675 (135 = 6 l. 15 s.

The Back Rule requires the first and secon⸱
to be multiplied, and that the third divide th⸱
Product. And this Rule is known, because th⸱
more will require less, or less more. Ex. If⸱
horses eat 5 pecks of oats in 3 days, 8 horses wi⸱
eat 5 pecks in a lesser time.

The Double Golden Rule, or Rule of 5 Num⸱
bers is of great use in many respects, and there⸱
fore as it is easily explained in *Moores Arit*⸱
take it from thence : Let that which is the pri⸱
cipal cause of loss or gain, interest, action, &⸱
be put in the first place ; that which betokene⸱
Time, distance of Place, &c. be in the secon⸱
place, and the remaining in the third ; und⸱
this Conditional part place the two other term⸱
each under his like ; and there will be a blan⸱
to supply under one of those above, either u⸱
der the first, second, or third. Ex. If one hu⸱
dred pound in 12 months gain 6 l. (this i⸱
Conditional part) what shall 50 l. get in⸱
months, place them down as in the Rule ; an⸱

lib.	m.	
100.	12.	6 l.
50.	3.	

here the blank is under th⸱
third term, but if the deman⸱
had been, in how man⸱
moneths would 50 l. ha⸱
gained 15 s, or if 100 , ⸱
12 month⸱

12 months gain 6 l. what shall the principal be, that in 3 months would gain 15 s.; in these two last cases the blank would have been under the first or second terms, there are but these Cases; Rule 1. If the blank be under the third term, multiply the three last for a Dividend, and the two first for a Divisor, the Quotient of these gives the sixth; $6 \times 50 \times 3 = 900$ and $100 \times 12 = 1200$ now $1200) 900,0 (,75 = 15$ s. But if the blank fall under the first or second term then the rule will be; Multiply the first, second and last for a Dividend, and the third and fourth for a Divisor, the Quotient is an Answer: This Rule shews simple Interest, and all belongs to it with ease, and was thus found. Set with Mr. Mern, P. T. G. for the principal Time, and Gaine in the Conditions, and p. t. g. answering,

it will be P. G. : : p. $\dfrac{G p}{P}$ and T. $\dfrac{G p}{P}$: : t.

$\dfrac{G p t}{T P} = g$. So that multiplying the 3 last for Dividend, and 2 first for Divisor is the first Rule, and because $\dfrac{G p t}{T P} = g$. it will be G p t

$= T P g$ therefore $t = \dfrac{T P g}{p G}$ and $p = \dfrac{T P g}{G t}$.

which is the second Rule.

12. To any two Numbers, to find a third in continual proportion, Rule. Square the second and divide it by the first.

CHAP.

CHAP. IV.

Rules of Practice,
IN
ARITHMETICK

For Interest, plain and spherical Triangles,
Measuring of Plains, Solids, Circles and
Spheres, Gaging, Fortification, Gun-
nery, Astronomy, Dyalling, making of
Watches and Movements, Geography,
Navigation.

§. 1. RUles of Practice in Arithmetick, first
learn to half a number from the left to
the right speedily ; As for Ex. 843076, the
half is 421538, beginning with 8 take 4; of
4 take 2, these are even and easie ; but for 3,
take 1, and carry 10 to the next, which is 1,
I take 5 remains 10, then for the 0, I take 10,
and set down 5, for 7, 3, and for 16, 8. This
brings shillings into pounds by cutting off the last
figure, and taking the half of the rest; thus 7846 s.
make 392 l. 6 s. &c.

2. Because that 12 pence make a shilling, it
will be well to be expert in Multiplying or Di-
viding by 12 : A small paper of duodecimal
Arith. was 11 years since drawn up at the de-
sire of Sir Rob. Long, and it seems admirable
with what ease and fewness of figures, that
Arithmetick will work all measures by foot and
inches, and 12 parts for the inch, and for shil-
lings and pence, and 12 parts of a penny: Here
must two figures or digits be added, viz. x for
10, and n for eleven, the Account will be
Unites, Dozens, Grosses, &c. and the parts will
diminish

minish accordingly : But here is not room to explain it, take an Example : A piece of black Marble 2 feet 9 inches and ¾ broad ; 3 f. 2 inc. ¼ deep and 8 foot 3 inch. long, how many feet? and what rate at 1 s. 3 d. ½ per foot.

In the first operation, 3†6=18, for which set down 8 (the overplus above 12) and carry one; then 3†9=27, and 1 I carried makes 28, for which I set down 4 the overplus above 12s and carry 2, the 12s in 28; then 3†2=6, and 6†2=8, the which I set down. Then I come to the Multiplier 2, and say 2†6=12, I set down 0 and carry 1; then 2†9=18, and 18†1=19, for which I set down 7 and carry 1, and say 2†2=4, and 4†1=5, which I set down. Thirdly, I take the multiplier 3, and say 3†6=18, and setting down 6 carry 1, then 3†9=27, and 27†1=28, for which I set down 4 and carry 2, then 3†2=6, and 6†2=8, &c. which three Products I add carrying 1 for every twelve and setting down the overplus, so is the solidity of the whole Marble 6 dozen and one foot, or

(1) Op. 2:96 (2 op.)

3:23	
846	61,4
572	13,6
846	3080
8:x946	1640
813.	614
2284	
5'122	7x:880
61:4x4=94 s.8 d. 3/4	

This Table of twelves, or shillings and pence is to be got without book.

li.	s.
12	1
24	2
36	3
48	4
60	5
72	6
84	7
96	8
108	9
120	10
132	11
144	12

D 3

7¾ solid feet and ⅔ and by the second operation,
the price will be 7 dozen and 10 s, that is 94 s.
d. ¾.

3. The Aliquot or even parts of shillings and
pound s are to be learnt, as 1 d. ½ is the ⅛ part,
1 d. the 12th part, 2 d. the sixth part, 3 d. the
¾ part, 4 d. the ⅓ part, 6 d. the half of a shil-
ling; 1 s. the 20th part, 2 s. the tenth, 4 s. the 5th
part, 5 s. the 4th part, 3 s. 4 d. the 6th part, 6 s. 8
d. the 3d part, and 10 s. the half of a pound; know-
ing these the price of any one thing will be
known, if 1 l. or 1 Integer of that thing be
known. At 6 d. the ounce, what comes 372
ounces, because 6 d. is the ½ of a shilling; take
half of 372 = 186 shillings: The practice you
have in every Book of Arith. Likewise you may
observe the even parts of other things; suppose
the great hundred 112 l. the half is 56, the
quarter 28, the eighth part is 14, the 16th part
7; so that at 54 s. the C. what comes 15 C.
3 quar. and 18 pounds, the whole hundred
comes to 40 l. 10 s. the ¾ is three fourths of
54 s. which is 40 s. and 6 d. Lastly, for the
18 l. find what 14 l. comes to, viz. 6 s. 9 d.
and 4 l. to 1 s. 11 d. in all 42 l. 19 s. 2 d.

3. The hundred weight whether neat, or the
great C. which is 112 l. it will be worth while
to give you the price of either at any small rate
the pound weight; Ex. at 3 d. ½ the pound,
what comes either C. to: Put the price of 1
pound into farthings, viz. 14; for the Neat C.
account twice so many shillings, and as many
pence as farthings; and for the great C. twice
so many shillings, and as many Groats as there
be farthings in the pound weight. Ex. 14 s. and
145

14 s. make 28 s. and 14 d. makes 29 s. 2 d. the
Neat C. and 14 s. twice, and 14 groats makes
32 s. and 8 d. for the great C. So daily ex-
pences are for every penny spent a day, one
pound, one half pound, one groat, and one
penny: 5 d. a day is after that rate 7 l. 12 s. 1 d.
There is constant use made of the great hun-
dred, therefore I have annexed a Table, which
in the first Column contains the price of one
pound from 1 farthing to 2 s. and in the second
you have the price of the C. weight; the greater
figures are pence, the lesser farthings. If the price
exceed the Table, take half, or ¼ of it, and dou-
ble or redouble the price; and so seeking in the
Table for the price of a C. weight, you have the
price of a pound or unite answering.

A Table.

A Table for buying and selling by the C. weig[ht]

l.p.	C. pr.	l.p.	C. pr.	l.p	pr.	l.p.	C. pr.
	l. s. d.		l. s. d.		l. s. d.		l. s. d.
1	0.2.4	**6.**		1	5.14.4	1	8.10.4
2	0.4.8	1	2,18.4	2	5.16.8	2	8.12.8
3	0.7.0	2	3.0.8	3	5.19.0	3	8.15.0
1	0.9.4	3	3.3.0	**13**	6.1.4	**19**	8.17.4
1	0.11.8	**7**	3.5.4	1	6.3.8	1	8.19.8
2	0.14.0	1	3.7.8	2	6.6.0	2	9.2.0
3	0.16.4	2	3.10.0	3	6.8.4	3	9.4.4
2	0.18.8	3	3.12.4	**14**	6.10.8	**20**	9.6.8
1	1.1.0	**8**	3.14.8	1	6.13.0	1	9.9.0
2	1.3.4	1	3.17.0	2	6.15.4	2	9.11.4
3	1.5.8	2	3.19.4	3	6.17.8	3	9.13.8
3	1.8.0	3	4.1.8	**15**	7.0.0	**21**	9.16.0
1	1.10.4	**9**	4.4.0	1	7.2.4	1	9.18.4
2	1.12.8	1	4.6.4	2	7.4.8	2	10.0.8
3	1.15.0	2	4.8.8	3	7.7.0	3	10.3.0
4	1.17.4	3	4.11.0	**16**	7.9.4	**22**	10.5.4
1	1.19.8	**10**	4.13.4	1	7.11.8	1	10.7.8
2	2.2.0	1	4.15.8	2	7.14.0	2	10.10.0
3	2.4.4	2	4.18.0	3	7.16.4	3	10.12.4
5	2.6.8	3	5.0.4	**17**	7.18.8	**23**	10.14.8
1	2.9.0	**11**	5.2.8	1	8.1.0	1	10.17.0
2	2.11.4	1	5.5.0	2	8.3.4	2	10.19.4
3	2.13.8	2	5.7.4	3	8.5.8	3	11.1.8
6	2.16.0	3	5.9.8	**18**	8.8.0	**24**	11.4.0
		12	5.12.0				

Tuns are brought to Hundreds by multip. by 20.

4. The last Note shall be, that in weighing of goods, the weights 1 l. 3 l. and 9 l. will weigh all from 1 l. to 13 l. 1 l, 3 l, 9 l, 27 l...

all from 1 to 40. 1 l. 3 l. 9 l. 27 l, 81 l: all from 1 to 121, &c.

At the latter end of the Book you have a Table for the summing up of Commodities, the use is plain by Inspection only.

§ 2. Rules of Practice for casting up of Interest money, whether Simple or Compound, rebates and values of Leases.

1. Note is of simple Interest, of use amongst Merchants, you must know readily to cast up the days betwixt any two named times: In one year 365¼, in two years 730½, in three years

334	Jan.	00
306	Feb.	31
275	March	59
245	Apr.	90
214	May	120
184	June	151
153	July	181
122	Aug.	212
92	Sept.	243
61	Octob.	273
31	Nov.	304
00	Dec.	334

1095¾ and likewise by this Table to find the days; Ex. 1. From the beginning of the year to the 11th of Oct. Oct. has 273 days, and 11 makes 284. Ex. 2. from 14th of March to the 16 of December, subtract Mar. 59 + 12 = 71 from Dec. 314 + 16 = 350 rests 279 dayes. Ex. 3. From 10th of Jan. 1673 to the 5th of Feb. 1674. Say 20 + 184 + 31 + 5 = 240 days. The Interest for one day of one pound at 5 pound per Centum is this Decimal ,0001369836, at 6 l. per Cent. ,000164384, which are gotten by dividing 5 and 6 by 36500 ¾ and so of any other : Now to find the Interest of any summ of money for certain days, first find the Interest of one pound for that time, by multiplying ,000164384 for 6 per Cent. by the days; and then that product by the summ of money

money gives your desire: or easily if you [a]
the Logarithm of 8.21586217 for 6 per Ce[nt.]
or 8.136665:8 for 5 per Cent. to the Log[. of]
dayes, and the Log. of the summ of money pr[o]
posed together, it gives you the Log. of th[e In]
terest; and to rebate or to know the pre[sent]
worth of any summ due hereafter, you m[ay]
find the Interest of 1 l. for that time, addin[g]
Integer to it, and divide the summ propound[ed]
by it, the Quot. is the present worth. Here [fol]
lows a Table of simple Interest of 1 l. for any [time]
under 10000 at 6 per Cent.

D	M			C		X		pr
	lib.	s.	d.	s.	d.		d.	
1		3:	2.452		3.945		.394	.0
2		6:	6.904		7.890		.789	.0
3		9:	10.356		11.835		1.183	.1
4		13:	1.808	1:	3.780		1.578	.3
5		16:	5.260	1:	7.726		1.972	.3
6		19:	8.712	1:	11.671		2.367	.3
7	1:	3:	0.164	2:	3.616		2.761	.3
8	1:	6:	3.616	2:	7.561		3.156	.3
9	1:	9:	7.068	2:	11.506		3.550	3

. The use of this Table is easie; the first Co[l]
lumn are days; and if used with the seco[nd]
Column are thousands; if with the third [are]
hundreds; if the fourth are tens, and the fi[fth]
are single Unites. Ex. What is the use of [it]
for 1732 dayes. An. 5 s.

			l.	s.	d.
8 d. 1/4 for ,25 = 1 f. 50 =	1000		0	3	3.4
	700		2	3	6
2 f. 75 = 3 l. and if you turn	30		1,		
the Interest of one pound	2			.07	
			5	8	33

found as before into deci-
mals, and multiply it by the summ propounde[d]
in decimals, it gives the Interest of that summ
And for equation of payments, or giving [...]
ti[...]

time, as at 2 three Months, or at 3 six Months, &c. or Weeks, Years, or Dayes, or the like; suppose three, 3 months, multiply the terms 3 and 3 makes 9, add the latter 3 makes 12, the half whereof is the equated time, viz. 6 months. So the equation for 4 six months is 15, viz. $16 = 24 + 6 = 30 \longrightarrow \frac{1}{2}$ 30 is 15. To conclude this Note of simple Interest practise is the double Gol. Rule taught before, it answers all questions whether of the principal, time, or gain.

2. Of Compound Interest, or Interest upon Interest. The Logarithms answer questions of this nature with great ease; and first if the Interest be at 6 per Cent. find the Log. of 106, divide it by 2 for $\frac{1}{2}$ Years, by 4 for Quarters, by 12 for Months, and by 365 for Dayes, and keep these Log. for Use. You have six Questions in *Moores Arith.* wrought at large, the following Examp. will make all plain for 1 l. viz. Mr. *Oughtreds* six *Theorems* after 6 per Cent. viz. A, B, C, D, E, F.

Log. of 1,06	0.025306
$\frac{1}{2}$ Year	0.012653
$\frac{1}{4}$ Year	0.006326
Month	0.002109
Week	0.000527
Day	0.000075

The. 1. P lends to R 1 l. for 3 years, what must P receive at the end of the term ? A.

The. 2. P hath owing from R 1 l. at the end of three years, and would know the worth in ready money ? B.

So that A answers the first Question ; that is, P must receive 1 l. and .191 of a l. that is , 3 s. and 10 d. And B the

Yearly.
1,06....0.025306
          3

A 1,1910 0 075918
B ,83962 5.924081 Ar.Co

B. the second, that is, 16 s. 9 d. 06. A is gott
by multiplying the Log. of 1,06 by 33 and B. to
Arithmetical Complement of A.

The. 3. P hath an Annuity of 1 l. *per An.* and
forbears payment to the end of three years, wh
will it amount to? C.

The. 4. R is to pay 1 l. at the end of three ye
u nto P, and would know what rent is to be p
yearly for that debt? D.

First, A. 1

is 1,191·1   A--1⎯,191 ⅌.281033
⎯,191, and   1,06-1⎯,065.778151
1,06-1⎯,06   C 3,1833   0.502882
After Sub-   D ,3·413 ⅌.497117 Ar. C
straction it

leaves the Log.6 of C l.3 s. 8 d. and the Arit
Complement is D. 6 s. 3 d. ¾.

The. 5. P has an Annuity of 1 l. *per an.* for th
years, and would know the present worth in re
money.

The. 6. P kath 1 l. to bestow of an Ann
for three years, and would know the yea
Annuity.

The Answer to
the 5th The. is E-
2 l. 13 s. 5 d. ¾
and the 6th F
7 s. 6 d. Thus

C	3,1833	0.502882
A	1,191	0.075918
E	2,6728	0.426964
F	,37414	⅌.573036

for 1 l. the Answers are fitted to all the 6 Qu
stions, and the same is to be perform'd a
the like manner, if the payments were half ye
1 s, quarterly, & c, taking the Log. answering
before. And after you have found your A
swer for 1 l. by adding its Log. to the Log.
any other summ, it gives your desire. Ex.
392 l. 10 s. were due 3 years hence, and I d
sire to know what it is worth to pay presently
I add the Log. of 352,5--2.547159 to the Lo

$\cdot$3.914081 found as before makes 2.471142 , which is the Log. of 295.97, or 295 l. 19 s. 6 d. the Answer.

Rules concerning Free-holds to be bought and sold.

The Annual Rent, divided by the bare Rate of Interest proposed, produceth the summ of ready money that Free-hold Estate is worth. Exam. 300 per an. after the rate of 6 per Cent. is worth 5000

l. ,06) 300,00 (5000.

And if the Rent be $\frac{1}{2}$ yearly or quarterly, divide by ,0296 and ,014674.

Any summ of money (1000 l.) lying ready for a Purchase being multiplied by the bare rate of Interest, (,06) produceth the yearly Rent. 1000x,

06 = 60,00 or 60 l. per annum.

The Annual Rent (60 l.) being divided by a summ propounded (1000 l.) quotes the bare Interest of 1 l. 1000) 60,00 (,06.

Divide Unity (1) by the bare rate (,06) of 1 l. the Quotient gives the number of Years purchased, ,06) 1.00 (16,6 5) 1,00 (20,8) 1,00 (12.

If the Rents be $\frac{1}{2}$ yearly or quarterly paid, work as you were formerly directed.

E

Y.	5 p.C	6 p.C	8 p.C	10 p.C	Y.	5 p.C	6 p.C	8 p.C	10 p.C

The first Column is of Years, the second is
time to Purchase; the first figure being Years,
the second Months. A Rent to endure 7 years
is worth ready money after 5 l. *per Cent.* 5 years
and 9 months; the third Column is at 6 l. *per
Cent.* the fourth at 8, and the fifth at 10.
5 l. *per Cent.* is at 20 years purchase, 6 l. at
years and 8 months; 8 l. *per Cent.* at 12 years
and a half; 10 l. *per Cent.* at 10 years: So the 5
l. and 6 l. *per Cent.* may be used for Free-hold
states, and the 8 l. or 10 l. for Houses.

§. 3. Of plain and Spherical Triangles.

Instead of Chords, the Sines and Tangents were invented, and brought to a Decimal Radius, and it might be wished that the Sexagenary Account be left off, and the Centesimal taken.

After the Logarithms you have a Table of Artificial Sines and Tangents to every degree and minutes.

The Sine or Tangent of any degree, and minute, if they be under 45 deg. are found by looking in the Column on the left side, the Degrees are in greater figures, and if above 45 deg. by looking in the Column, on the right side, accounting from the bottom towards the top. *Examp.* The Sine of 13°. 30' will be found 9.368185 ; the Tangent 9.380354 ; the Sine of 67°. 20' will be found 9.965090 : the Tang. 10.379213 : The Complement of any degree and minute being the Remainder of the same to 90°, answers in the same line in the two outmost Columns ; as to 22° 10' answers 67° 50', and so doth the Sines and Tangents, for the Sine of 22°. 10' being 9.576689 , the Sine 9.966653 being its Complement or Cosine of 67°. 50' stands next ; and so of the Tangents.

Now to find the degree and minute answering to any Log. given ; suppose the Sine 9.457584, I seek this in the Table and find it answers 16°. 40' and to this Tangent 10.475480. 71°. 30', and if you seek for every second, you must take the difference of those two Log. betwixt which yours fall , and the difference betwixt yours and the lesser , then say, as the first Diff. is to the other difference ; so is 60 to the seconds sought. *Ex.* The Sine 9.500163 being given, the next less in the Table 9.499963, the difference 200. The Tabular diff. 379, then say, if 379 60 : 200. it will give 32, so the cor-

respondent

re´ondent degree, minute, and second, with
180. 16'. 32". This being learnt, we come to the
Doctrine of plain Triangles, but first know the
Characters ; ∠ an Angle ; rt ∠ a right Angle ;
l. a fide ; Hyp. the Hypothenuse ; Ba. Base ; Ca.
Cathetus ; △ Triangle ; Dat. given ; S. Sine ; T.
Tangent; Cos Cosine ; Cot. Cotangs.

1. Of plain △s, let every rt angled △ be noted with three Letters, A, B, C ; let A
be the rt ∠, BA the Base, CA the Cathetus or Perpen. and B C the Hypothenuse, and all Oblique △s with B C
D, let BD be the Base ; then observe
these *Propositions*.

Prop. I. The Sides and Sines of the opposite
Angles are proportional, and in any Triangle
where two Sides , and one Angle opposite are
given, and it be required to find the Angle opposite to the other ; As l : . S: ∠ Opp : l :
S: ∠ required : Or if two Angles, and the Side
opposite, the one be given, to find the l: opposite to the other ; Say, As S: ∠ l: opp : : S : ∠ l.
required ; this reacheth generally to all △s. Note
that in a rt △ △ if one acute Angle be known, the
other is known, because it is the Complement to
90°. and in an Oblique △ if two Angles be
known, the third is given, because the Complement to 180°.

Prop. II. In rt ∠△s. As one side. to the other :: so is Rad. to the Targ. of an
∠ opposite the other, B A . C A : : Rad :
t. ∠ B C.

Prop. III. In every plane △. As the summ of
the two Sides. is to their difference : : So is the
Tangent of half the summ of the two opposite
Angles. to the Tan. of half their Difference; therefore if two Sides and the Angle included be given,
the rest will be known.

. *Prop. IV.* As the greater side, to the summ of
the

...he reſt ∷ ſo is the Diff. of thoſe two remaining Sides. to the difference of the ſegments of the Baſe, the Perpendicular will fall in the middle of the Remainder.

Theſe four *Prop.* will reſolve all plain △s.

Rad. 90°.--	10.000000	
B C 1277.--	3.106191	
∠ B. 28.20'.	9.676528	
C A. 606. --	2.782519	

Ex. In the △ BA C rr ∠ at A. Let the Hypothenuſe B C be given, and ∠ B to find the Side C A. By the I *Prop.*

Rad. 90° --	10.000000	
B A. 1124 --	3.050766	
∠ B. 28. 20'	9.731716	
C A. 606. --	2.782512	

Having B A the diſtance from any place to the foot, 1124 feet or yards, and ∠ B. 28. 20, to find the height C A. 606 feet or yards:

By *Prop.* II. Fig. (3.)

In the Oblique ∠ △ D B C, *Fig.* (3.) having ∠ C D B 43°. 20', and the ∠ C B A. 58°. ∠ D B C will be 122, and the ∠ D C B 14°. 40', the firſt two ∠s are had by obſervation, the o-ther Complements, by the I. *Prop.* you may have D C 335 , and B C 271, which are the diſtances from D and B to C, though you came no nearer than D. Likewiſe in the rt ∠ △ B C A, ſuppoſing C A ſome height en-approachable, af-ter the Angles at D and B be taken, and the diſtance

S:B. 14°. 40'	9.403455	
D B. - - - 110	2.000000	
S: C.--43. 20	9.836477	
I: B C --- 271	2.433022	
S:DBC. 58°.	9.928420	
t: D C.-- 335	2.524965	

B C 271,as before; you may find by the I Pr. C A 230 feet, yards, &c. the height, and B A the diſtance 143, 7; and by theſe two laſt *Exam.*

E 3.   all.

all heights and diſtances whether acceſſible or [...]
are taken.

2. Of Spherical Triangles, and firſt of rt ∠ △[...]
In theſe there are 5 parts, beſides the rt ∠[...]
(which is no part) to be conſidered; in the[...]
∠ B C. (Fig. 4.) A is the rt ∠, the Sides B[...]
and C A are taken ſimply, which make tw[...]
parts. the ∠ C and B, and the Side B C by the[...]
Complements which make three parts, five i[...]
all: Three of theſe alwa[y]s fall into the Que[...]
ſtion, whereof two are given, and one deman[...]
ed, and theſe three in the Queſtion either[...]
all together, as B. B A. A C. or B A. A C[...]
C; or A C. C. B C or B C. B and B A. or C. B[...]
and B, in all whi[c]h five caſes B A. A C. C. B an[...]
B C are the means, and the other two the ex rem[...]
or a ſunder or disjun[c]t; as, B A. B C and C: B C[...]
B A. C A: C. B and B A, wherein B A, B C a[...]
C which are ſeparated from the other two, are c[...]
led the Intermedials, the other the Oppoſite[...]

A. 1. As Tan. of one Extreme. To the Si[...]
of the Mean :: So is Rad. to Tang. of the[...]
ther.

A. 2. As ſi. co. of the one Oppoſite; to ſi[...]
of the Intermedial ;: ſo Rad. to the Coſine of the[...]
other.

By theſe 2 Ax. and the former obſervation[...]
any part of a rt ∠ △ may be gotten by knowin[...]

two parts : Ex. b[...]
the △ B A C. wher[...]
let B repreſent th[...]
Equinoſtial p[o]int[...]
and the Angle of the[...]
greateſt Dec. 23[...]
30', and B C a pa[...]
of the Ecliptick 34. 20. I demand C A th[...]
Dec. Here B and B C are given. C A deman[...]
ed. C A is disjoyn'd, and B, B C are the op[...]
poſites; therefore by the ſecond Ax. As R[...]

As, Rad. ---	10 000000
Si. B C 34. 20.	9.75 284
Si. B. 23. 30.	9.600700
Si. C A, 3°.	9 351 84

Cofy, B C :: Sico. B. Sine of C A , but you
are bid to take the Complements of B and B C,
therefore as in the work R. Si. B C :: Si. B.
Sine C A ; this is plain and sufficient for it ∠
△s.

Of oblique Spherical Triangles the parts
are 6 , 3 sides and 3 Angles , whereof 3 are
given, and 1, 2, or 3 may be sought ; four of
these six are called Ingredients, whereof 3 must
be given and one sought : And of these four there
may be three several Divisions ; first, they may
be opposed one to another , as 1. to ∠ and 1 : to
∠ or contrarily, and then S: ∠. S: 1. :: S∠.S.
1. or S: 1. S: ∠ :: S. 1. S. ∠. Secondly, they
all follow together ; or thirdly, three together
and one removed : In the two latter the part.
sought may be found at two Operations and no
more , by letting fall a Perpendicular , which
must alwayes fall from or upon one of the Ingre-
dients, and never from or upon two. For the
Calculation of any of these observe the Rules fol-
lowing.

I. The Perpendicular being let down, the two
Ingredients left intire annexed and given, must
be marked with the letters, B and B C the ∠ and
Side given.

II. One of these two, either B or B C must
begin the account of the four Ingredients, in
the Question, and the Perpendicular must alwayes
fall upon B D extended if need be.

III. If the ∠s at B and D be both acute, then
the Perpendicular will fall within the △, and then
D A = B D - B A and ∠D C A = ∠B C D - B C A,
as in the 5 Figure : But if the one of B or D be
obtuse and the other acute, then will it fall with-
out, as you may perceive in the 5, 6, and 7 Fi-
gures : Then D A = ; A+B D and ∠D C A = B.
C D+B C A, as in the 6.b Fig. or D A = B A - B
D and D C A = B C A - B C D, as in the 7th Figure.

E 4   IV. The

IV. The order being begun as before, either at B or B C either all four will follow one another, or else three of them, and the fourth removed from the rest.

V. After the Perpendicular be let fall, the Sides B A, A D, or the ∠s B C A, or A C D, or A C B are found out, as in rt angled Triangles.

After D A and B A, or ∠ B C A, or A C D be found as before, the Triangles are found and performed by two *Cases*, and each *Case* two Problems.

Case I. Where all four Ingredients follow each other.

1 *Prob.* Leader B C thus, B C. B. B D. D and either B D, or D sought, as sine D A. S. B A :: t B. t D.

2. *Prob.* Leader B thus B. B C. B C D. D C. and either B C D, or B C is sought ; say cosy. D C A. cosy. B C A :: t. B C. t D C.

Case II. Where three follow immediately and one separated.

1. *Prob.* Leader B C. thus B C. C. C D and B D, and either D C or B D are sought ; say Cosy. B A. Cosy : D A :: Cosy : B C. Cosy : D C.

꙼ 2. *Prob.* Leader B, thus B. B C. B C D and D, and either D or B C D are required ; say, si: B C A. S : D C A :: Cosy : B. cosy : D.

Lastly, in the two *Cases*, first where three Sides are given to find an Angle: For *Ex. Fig.* 8. *b*, In the Triangle B C D, let all the Sides be given, viz. B C 38. 30. G D 70. and B D 60; and let the Angle C be sought : First, set down the Arith. Comp. of the Sines of B C and C D including the ∠ sought. Take the Difference of these sides, and under that Diff. set down the third

Sĩ.

C 38. 30 Arith. Co : 0.005850
CD 70. 00 Arith. Co : 0.027014
  31. 30 Diff.
BD 60. 00 third side
  Z. 91. 30
  X. 28 10

half Z. 45. 45. Si : 9.855096
half X. 14. 15. Si : 9.391205
    Sum —— 19.479165
    half Sum— 9.739582
Sine of 33°.18 doubled 66 36 ∠ C.

third side, take their sum and difference and set down their Sines; lastly, sum up all four Sines, the half sum will find out an Arch among the Sines, which being doubl'd will be the ∠.

And if three Angles be given to find a side, if instead of the greatest ∠ you take its Complement to 180, the Angles will be sides & sides ∠s, as in the last.

§.4. Of Longimetry, Planometry & Stereometry.

Note I. The measures used for lengths, as you had them in the CHAP. II. are either Inches divided into ten parts, Feet divided into 100 parts, or 12 inches, a Gad or Rod divided into ten feet, and a Perch or Pole divided into 100 links, containing 16¼ feet, or 18 feet; these or any of these may be used as occasion requires.

2. Care must be had, that in measuring any Line or length whatsoever, you deviate not from a strait Line, therefore set up small pikets betwixt you and the Mark that may direct the Line, or if you measure by a four pole Chain, then the hindermost man look that the Leader go streight, or cover the Mark. If a Line decline, and you would know the Horizontal Line in going down a precipice at the end of the Gad or Rod held Horizontally, let fall a small stone or any small weight that will shew the point where you must hold Horizontally again.

To level a length or line, or to know what difference of height in rising or falling betwixt place

place and place, which is a very useful practice
for carrying of water, or of underground Aditus
or Soughs, take these Rules: Let your Instrument
be carefully and truly made, whether it be a Water
Level, or which in my opinion is the best, a brass
T, the sights to be two prospect glasses; and such
you may have made of Mr. *Marks*, an Excellent
Math. Instrument maker, at his house neer *Sant-*
set House towards the *Savoy*, and the water, if
him direction is given about it: This kind of In-
strument will suffer a distance of $\frac{1}{4}$ of a mile, or
more if need be; & there must be two mark-boards
placed on pike staves, that your Companions may
lift up or down as you shall direct them.

Set the Level as neer as you may in the midst
betwixt the two Marks, which your Companions
hold upright in their hands with the slipping marks,
and first turning to one, cause him to hold or move
his sight even with the level sights, and so the o-
ther; the Difference betwixt those sights in half
and tenth parts gives the ascent or descent: and this
is for one simple station; but if it require more
stations with ascents and descents, then in a Note
Book set down your back stations in one Column,
and your fore-stations in another, summ up both
the Columns, and take the Difference of them, if
they be equal, the two places are level; if your
fore stations exceed, then the difference is lower,
if otherwise, higher, a little practice will inform
you sufficiently; in carrying a Stream or River,
as the New Water from a little above *Ware* to *Lon-*
don, or elsewhere, you must allow a Foot, or a
Foot and two inches for a mile in descent, or
more, if your fall require it; and this because
the distance of the Tangent from the surface of the
Globe of the Earth in every mile; and though in
a mile it will be found but 6 inches, yet it is bet-
ter to hold to the surer side. Now for common
Sewers or Passages to carry away the water

dirt of streets in Towns; for every ten feet you ought to allow 2 inches or 3 as your fall may be, which in every 100 feet will be 1 foot 8 inches, or 2 feet 6 inches.

3. For the length of unapproachable Lines, as those of places besieged, or of heights or distances, they are found by resolving a Triangle, that hath one side, and all the Angles given, as in Prop. 4. of plain Triangles is set down, as you may see in Fig. 3d. Care must be had, that the Angle B C D be not too acute, viz. never less than 2 degrees, and therefore it will be best if the ground will give leave, to go from B not in the right line A B D, but to go off from B towards F at right Angles.

For a diversion I will give the heights of some Pyramids, Steeples, Obelisks, and Pillars in the measure of English feet; As when St. Paul's Steeple had its Spire on, the stone work was 260 feet high, &theSpire as much, which was 520 feet in all, and will be found as high as any Steeple in Christendom, only that at Cremona in Italy being 528 feet excepted, the Ball on St. Peter's in Rome is 466 feet; the Steeple at Roan in Normandy is 399 feet; at Strasburgh in Germany 431; at Landhoven in Bavaria 451; at Medena in Italy 279 feet; the Tower Asinel in Bononia in Italy 316 feet; Lantern at Genua 324 feet; the highest of the Pyramids 1350 feet, the lower Pyramids 883; Boston Steeple in England, a stone Steeple without Spire is 264 feet; the height of the Obelisk in Rome removed by Fontana to St. Peters, was of one stone 78 feet and a half high, 9 feet 2 inches square at greater end, and 6 feet 2 inches at the top, it stands now upon a Pedestal of 12 feet and a half high, and the height of the brazen gilded Cross is 19 feet and half, so now the whole height is 110 feet and a half in all.

4. Before we come to the measuring Plains, it will be requisite to shew, (1.) To raise a perpendicular

dicular from a Line ; (*Fig.9.*) suppose on *a*, ta
ab=*ac* open your Compass to above half *b c*, an
cross two arches at *d*, *a d* is a Perpendicular. (2)
To do it on the end of a Line, strike an Arch *d h*
set the same wideness from *d* to *b*, and strike ano
ther Arch at *c*, which with a Ruler laid upon *d* and
b cross at *C* , then is *c a* a Perpendicular. (Se
*Fig.*10. (3.) To let fall a Perpendicular from *a*,
upon the Line *b c*, (*Fig.*11.) setting one foot in *a*,
cross the Line in *b* and *c*, from *b* and *c*, opening
the Compasses make a cross at *e*, lay a Ruler by *a*
and *e*, and draw *a d* which is a Perpendicular to
b c. Lastly, because hereafter there is great use made
of a Square, I shall shew you how any Joyner o
skilful Carpenter may make one that will very
well serve your turn for surveying or plotting and
Grounds, Yards or Courts, and for measuring the
same. Get a dryed piece of Box or Pear-tree that
will bear 3 inches, or 3 inches and a half Diame
ter, and turn it flat on the top round, with a need
to fit for the head of a staff ; find the Center, and
draw 2 or 3 Concentrical Circles, as you see (*Fig.*
12.) and Circles on the edge, divide the Circle
into four parts, as you see in the Figure *a d b c*, the
take a whipsaw very thin, and saw by the marks the
two Lines *a b* and *c d* at right Angles pretty deep,
this will make a good Instrument for setting off
Perpendiculars when you have occasion :

Suppose (*Fig* 13.) *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, were a
field, I come to *a*, and setting a Becon there and
at the corners, I measure *a c*, and as I go find to
what length by the square, the perpendiculars to
x d and *k b* will be, I measure all those Perpendi
culars and set them down in my Book, I measure
e b and the perpendiculars *m p* and *n o*, and so all
the rest as you see in the Figure ; and to lay the
observations down, I do no more but draw a Line
a c by the scale, and prick down the points *i k* and
x, and raising Perpendiculars I set off *x h*, *k b*

and x d which give me a, b, c, d and h, I draw c b
and upon it prick down n, y, and m, and set off
o and m p, and so I work with the rest of the
Figure, and I deal so with the rest of the Closes if
there be more, and add all together.

Lastly, to find the length of a Circular Line,
either whole or part, from De-
grees and Decimal parts, may
be done by this Table, the first
Column are Degrees and Decimal parts, second Radius is
Unity, as for *Ex.* 30-,52359
32o. and 16' Dec.
parts : *An.* ,56128
of 100000

,017453292	
,034906585	
,052359877	30-,52359
,069813170	2 ,03491
,087266463	1 ,00174
,104719755	6-,00104
,122173047	
,139626340	,56128
,157079633	

Note II. Planometry, or the measuring the su-
perficies or planes of things is done with the
squares of such measures, as a square foot, square
inch, square yard, square perch, that is by squares,
whose sides are an inch, a foot, a yard, a perch;
so that the Area of any superficies is said to be
found, when I know how many such square inches,
feet, yards, &c. it containeth.

1. The Area's of squares and oblongs are known
if you multiply one side by another.

2. The Area of any plain Triangle is gotten
by multiplying the Base by the Perpendicular, and
taking half the sum, or the Base by half the Per-
pendicular, or the Perpen. by half the Base.

Or without the Perpendicular at all, add up all
the sides and take half the sum, from this half sum
take every side, which call the three Differences,
multiply these three Differences, and the half sum
continually together, and the square Root of the last
Product shall be the Area of the Triangle.

3. To measure any Regular Figure that has equal
sides, multiply half the sum of the sides by the Per-
pendicular from the Centre to one of these sides :

F   To

To find the Perpendicular, conceive a Triang[le] whereof one side is the side given, the Angle op[po]posite is the ∠ at the Centre, the other Angle [one] of its Complement, to find the Perpendicular.

	Q.	L.
△	658	1,520
□	1,000	1,000
5	1,312	,7624
6	1,512	,620
7	1,904	,525
8	2,196	,455
9	2,487	,402
10	2,769	,361

This Table will present [&] give you the Quadratrix unde[r] Q. or the side under L. for a[ny] of the ten Regular Figure[s] whose side is 1. Ex. Suppose [the] side of a Pentagon be 70,[51] what is the superficies: Say, [As] 1. 1,312 :. 70,51. An. 92,51[9] Quadratrix and 92,52 x 9[2,52] = 8558. Having the superfic[ies]

take the sq. Root of it, and say, As 1. ,7624 :: Q. to side.

4. The Area of any four sided Figure, two [sides] whereof are parallel, is gotten, if you multi[ply] the perpendicular from the one parallel side u[nto] the other, by the half sum of those parallel sides.

5. If the figure be of many sides, cast them int[o] Triangles, as you see in Figure (13.) And if a[ny] side be crooked as you see *h g* in that Figure, d[raw] a Line that shall leave as much out as it takes [in] or if it be irregular towards around, as in [Fig.] (14.) form a Triangle, as *c b d* that shall equal[l]

6. The dimension of Circles, and other rou[nd] Figures are gathered from their Diameters or C[ir]cumferences; let D signifie the Diameter, P[e.] Periphery, Dq, Pq the square of the D or P[e.] the side as before, ⊙. the Circle, R. Radiu[s] half of the D. Then,

As, 7. 22 or 113. 355, or 1. 3.1415926 :: [So] is any D. to P. and so Dq. to the superficies [of a] sphere, and so is Dx the Axis of a Cylinder t[o the] superficies, and so is half D into the side. t[o the] superficies of a Cone; and so is the square of [the] Chord of half the segment of a Sphere, to the [su]perficies of that segment.

(63)

As, 22 7 or 355. 113. or 1.0.3.8310 :: ſo P. D⁰ to ſuperficies to the Dq of the Sphere.

As 7×4 22. or 14.11. or as 1. to .785399 : ſo Dq. Area: and ſo is the ſq. of the D×1. ſolid: Cylinder. ſo Dq×⅓Ax: to the ſolid: of the Cone :

A, 22.7×4 or 11. 14, or as 455.452 or 1. 1,27323 ⁾.: ſo is the Area of the ☉ to the Dq.

As, 12×4 7,or as 88.7. or as 1420 113. or 1.to ⁰79577 :: ſo Pq. Area of a ☉ and ſo Pq×1. to the ſolid of a Cylinder.

As, 1. to 707107 :: D. to the Root of a ſquare to be inſcribed in a Circle. As 1.385217 :: D. to the Root of a ſq. equal to the Circle, which is the ſquaring of a Circle.

As 1. to ,80604 :: D.to the Root of a Cube e-qual the Sphere.

As 1. to 1.772454 :: D. to the Root of a ſq. e-qual ſuperficies of a Sphere.

As 1 to :523599 :: Cube of D, to the Sphere.

As 1,to 13909859 : Sphere. Cube of the Diameter.

As 1.to ;282095 :: ☉. to root of a ſquare = to the Area ☉.

As 7.22×4. or 1.12;56371 :: ☉. Pq.

As 1.;225072 :: ſo is P. to the root of the in-ſcribed ſq. in the ☉.

As 1.;256556 :: P. Root Cube of a ſolid=the Sphere.

As 1 ;564189 :: P. Root ſq. = ſuperficies of the Sphere.

As 1. ;016887 : : Cube P. to the Sphere.

As 1 59;217626 :: Sphere to Cube of the P.

As 7×6. 22.or 1 ;236 :: D cubed.Sʒlid:Sphere.

As 22. 7×6 or 1. 1;99986 :: ſolidity. D cubed of a ſphere.

A Cone, a Sphere, and a Cylinder, that have the ſame height and Diameter, if the greateſt Circle be equal, are as 1,2 3 ; therefore a Cone is ⅓, and a ſphere ⅔ of a Cylinder of the ſame height

F 2   and

and D. therefore, As 1, 25;1;27 :: so D cube Cylinder.

7. The practise followeth : I. In surveying measuring of Land; measure with a Perch or Pole =16 ½ feet divided into 100 parts, then by the foresaid Rules how many sq. perches there are; which is the Area of that Close or ground; which divided by 160 square perches (for so many are in an Acre =40 x 4) it gives you Acres, the Remainder accounting 40 Perches for a Rood, are Roods and Perches.

	M.	C.	X.
	ac. r. p.	a. r. p.	r. p.
1	6. 1. 0	0. 2. 00	10
2	12. 2. 0	1. 0. 00	20
3	18. 3. 0	1. 3. 200	30
4	25. 0. 0	2. 0	1. 00
5	31. 1. 0	3. 0. 20	1. 10
6	37. 2. 0	3. 3. 0	1. 20
7	43. 3. 0	4. 1. 20	1. 30
8	50. 0. 0	5. 0. 0	2. 00
9	56. 1. 0	5. 2. 20	2. 10

This little Table turns Perches into Acres, Roods, Perches upon sight; the Numbers under x. are Acres, under r. are Roods: for the first Column turns either so many thousands under M. or so many hundreds under C. and so many Tens under X.

	ac. r. p.
7000 ---	43. 3. 0
800 ---	5. 0. 0
50 ---	0. 1. 10
4 ---	0. 0. 4
	49. 0. 14

As for Exam. 7851 Perches are given, which I set down as you see, and take the number of Acres, Roods and Perches answering each figure, and it makes in all 49 Acres and 14 Perches. Sometimes in small Backsides, Courts, or other small places the measure may be by the Foot, and then this Table turns any number of Feet into Acres, Roods,

C. M.				X. M.				M.		C.	
a.	r.	p.	f.	p.	r.	p.	f.	p.	f.	p.	f.
2.	1.	7.	86	0.	0.	36.	189	3.	183	0.	130
4.	2.	14.	171	0.	1.	33.	126	7.	94	0.	200
6.	3.	21.	257	3.	2.	30.	53	11.	05	1.	28
9.	0.	29.	70	0.	3.	26.	252	14.	189	1.	128
11.	1.	36.	156	1.	0.	23.	179	18.	99	1.	228
13.	3.	3.	240	1.	1.	20.	100	22.	11	2.	56
16.	0.	11.	54	1.	2.	17.	33	25.	194	2.	156
18.	1.	18.	140	1.	3.	13.	232	29.	106	2.	256
20.	2.	25.	225	2.	0.	10.	159	33.	17	3.	84

Roods and Perches at the first view, to be operated with feet, as the last *Ex.* Roods, Perches, the numbers under feet are odd feet, the second Column is one Hundred Thousands, the third Tens of Thousands, and the fourth M. and the last Hundreds.

One superficies is to another as the squares of their like sides, therefore as the square of 18,5 to sq. of 16,5, or as the squ. of 12 ($=144$) to the sq. of 11 ($=121$) :: so are the Content in Statute Acres, to the Content in Woodland. and as 144, 196 :: so Forrest. Ac. to Woodland Acres. and as 121, 196 :: so is Forrest Acres, to Statute Acres.

II. In measuring of Pavings, Plaisterings, Wainscotings and Paintings, you use the yard square; or if you measure by feet and tenth parts, then every 9 feet squ. makes a yard, all of them require the whole superficies, therefore you must measure wherever the plane or brush goes. The Paviers must lay good foundations and ram well; the Plaisterers work with good Materials and Size; the Wainscoting well wrought, and the Painters to lay a good ground, and work with Oyl and white Lead.

III. Carpenters work, as Flooring, Partitioning, Roofing, and so Tiling, Slating, nay, lately in *London*, the ground Plot of whole buildings are measured by the square of 10 feet $=100$ sq. feet;

so

so that if you measured by a 10 foot Rod, sai[d]
very foot divided into 10 part, all will come in[to]
feet, and cutting off the two last figures, the [re]
main will Flores or squ. of 10=100.

Brickwork is measur'd by the Perch of 16½ fe[et]
the best way is to measure by the ten foot Rod [I]
spoke on, and casting up the Area by multiply[ing]
one side by another, it will produce squ[are]
feet which by this Table is presently broug[ht]
into square Perches : The first Column [is]
feet or Thousands or Hund: or Ten feet; an[d]
either so many X M. second, third, four[th]
and fifth Columns answer : Ex. In 36542 f[q.]

	X M.			M.			C.			X.	
	p.	q.	f.	p.	q.	f.	p.	q.	f.	q.	f.
1	36.	2.	63	3.	2.	41	0.	1.	31	10
2	73.	1.	58	7.	1.	26	0.	2.	62	20
3	110.	0.	53	11.	0.	5	1.	0.	26	30
4	146.	3.	55	14.	2	52	1.	1.	57	40
5	183.	2.	40	18.	1.	31	1.	3.	20	50
6	220.	1.	35	22.	0.	10	2.	0.	52	60
7	257.	0.	43	25.	2.	37	2.	2.	74	1.	2
8	293.	3.	41	29.	1.	36	2.	3.	47	1.	12
9	330.	2.	25	33.	0.	15	3.	1.	10	1.	22

feet what perches, quarters and feet ? *An.* [111]
perches, 0. q. 57 feet. Th[is]

32000	110. 0. 53
6000	22. 0. 10
500	1. 3. 20
40	40
2	2
	134. 0. 57

supposeth that the brickwo[rk]
is brick and half thick, bu[t if]
the wall be more or less thi[ck]
account it by half bricks, (as [2]
3 for brick and half, 4 for [2]
bricks, 6 for 3 bricks, &c.)
and say, As, 3. to any oth[er]
wall in half bricks :: so are the perches found [by]
measure. To the perches to that other wall in [2]
bricks. Note that 272 one qr. of sq. feet, is a perc[h]
[a]nd one q. 236 half, and 204 ; 3 q.

Taped[ry]

Tapestry is measured by the stick=27 inches or three quarters of a yard, in a stick=729 square inches: This Table gives sticks, quarters and inches answering to any number of squ. inches, measured by inches.

	X M.			M.			C.	
	s.	q. inc.	s.	q.	inc.	q.	inc.	
1	13.	2. 159	1.	1.	88	1.	100	
2	27.	1. 135	2.	2.	177	1.	18	
3	41.	0. 112	4.	0.	84	1.	118	
4	54.	3. 89	5.	1.	172	2.	36	
5	68.	2. 65	6.	3.	79	2.	136	
6	82.	1. 41	8.	0.	168	3.	54	
7	96.	0. 19	9.	2.	74	3.	154	
8	109.	2. 176	10.	3.	163	4.	72	
9	123.	1. 153	12.	1.	70	4.	172	

Board, Glass, &c. are measured by the foot, divided into 10 or 100 parts, or by inches and

	M.			C.			X.	
	f.	q.inc.	f.	q.	inc.	q.	inc.	
1	6.	3. 28	0.	2.	28		10	
2	13.	3. 20	1.	1.	20		20	
3	20.	3. 12	2.	0.	12		30	
4	27.	3. 4	2.	3.	4	1.	4	
5	34.	2. 32	3.	1.	32	1.	14	
6	41.	2. 24	4.	0.	24	1.	24	
7	48.	2. 16	4.	3.	16	1.	34	
8	55.	2. 8	5.	2.	8	2.	8	
9	62.	2. 0	6.	1.	0	2.	18	

ten parts, and then this Table will turn the inches square into feet, quarters and inches 9842 sq. Inc. =68 f. 1 q. 14.

	f.	q. inc.
9000	62.	2. 0
800	5.	2. 8
40		1. 4
2		2
	68.	1. 14

F 4

In either Board or Glass, if the breadth be given, to find how much of that breadth will make a foot in length; divide 1. by the breadth in feet and 100 parts, the Quotient gives part of a foot; if by inches, divide 144 (12x12) by inches and parts.

If you measure by inches and 8 parts in the Figure adjoyning, you may turn them in feet and ten parts by inspection, the two middle lines being inches and eight parts, above you have feet and ten parts, below timber measure.

Note III. Stereometry, or measuring of Bodies, has two Multiplications or three Dimensions, and is valued by the Cube of some famous measure; as an inch Cube, a foot, a yard, or perch Cube.

A perfect Cube is known, by multiplying the side into it self, and that product by the side again.

A parallelipidon, or an oblong Cube, a Prisma, or a Cylinder or Pillar; first, get the superficies at the end, and multiply that by the height or perpendicular from the top of the Body to the Plane below.

A Pyramid or Cone is measured by the superficies of the Base Mult. into one third of the height.

The five Regular Bodies, *viz.* Tetrahedrum, Cube, Octohedrum, Dodecahedrum and Icosahedrum are measured as in the Table : Say,

1. side of the Dod : : ,771 Cube.

	Cub.	Side.
Tet.	,490	2,040
Oct.	,778	1,285
Cube	1,000	1,000
Icos.	1,318	,771
Dod.	2,003	,507

1. Cubat. of Dod : : 1,318 side.

The Cubatrix multiplyed into it self twice gives the solid; and is the Cube Root of that solid body.

To measure the Frustrums or parts of Pyra-

mids or Cones, (as tapering Timber is) supply the Pyramid or Cone, saying; As differ. of the bredth at the two ends. To the length between them :: so the bredth of the greater end, to the whole length of the Pyr. or Cone.

This gives you the length of the top part; find as before the solidity of the top-part, and the whole severally, subtract the sol. of the top from the whole leaves the sol. of the Frustrum. *Fontana* found the Obelisk by him removed to St. *Peters* to weigh 529 Tuns 11 C. 2 quarters and 3 ½ Averd.

The usual way for this tapering Timber, is to measure the superficies in the midst, and multiply it by the length, which though it be a false Rule, yet if it be done at many lengths, suppose at every 5 or 6 feet, it will be very near.

All bodies one to another are in proportion as the Cubes of their like sides.

The measuring of all bodies that have curv'd superficies or plain-curv'd, follows.

Spheres, Cylinders and Cones, you have their dimensions and measures amongst the dimensions of Circles and round Figures in Planimetry.

To measure the truncus or part of a Cylinder that leans, take the superficies of the Circle, and adding the longer and shorter sides of the Truncus, take half, let that be the heighth.

The sector of a Sphere is measured by multiplying its superficies spherical, by one third of the heighth.

The segment of a Sphere, measure it as if a sector and subtract from the sector the solidity of a Cone whose Apex is in the Center, and base the Area of the segment.

The solidity of a spheroid is gotten by multiplying the greatest Circle into two thirds of the Axis, about which the spheroid is made.

The

The solidity of the Trunck of a spheroid cut off with two Circles at right Angles with the Base, such as our wine Cask are, is gotten, by adding two thirds of the Area of the Circle at the bung or middle, and one third of the Area of the Circle at the head together, and multiplying the sum by the length.

The solidity of an obtuse Parabolical Conoid is gotten by multiplying the Area of the Circular base in half the Axis, but of an Acute one into 8 fifteens of the height.

2. The practice for measuring solids follows, first for measuring Timber or Stone, by the foot divided into 10 or 100 parts, multiply as before taught, the Answer will be in feet and decimal parts; and if you measure by inc. & 8 parts you may put the measure into feet and decim. parts by the Table annex'd, &c. if you must measure by inch measure, cast all up in solid inches, and then by this Table find the solid feet, quarters and inches.

324	3 qu.
216	2 qu.
108	1 qu.

If any piece of round Timber or square be

ven , and it be deſired what length of it will make a foot , divide 1728 by the inches ſquare at the end it anſwers the Queſtion.

	X M.			M.			C.	
	f.	q.	inc.	f.	q.	inq.	q.	ing.
1	5.	3.	64	0.	2.	512	0.	100
2	11.	2.	128	1.	0.	272	0.	200
3	17.	1.	192	1.	2.	408	0.	300
4	23.	0.	256	2.	1.	112	0.	400
5	28.	3.	320	2.	3.	248	1.	068
6	34.	2.	384	3.	1.	384	1.	168
7	40.	2.	164	4.	0.	88	1.	268
8	46.	1.	80	4.	2.	224	1.	368
9	52.	0.	144	5.	0.	360	2.	036

But if you have the ſuperficial Content at the end of the Timber or Stone, and deſire to know the ſolidity of one foot, the Table following will give it you quickly. *Ex.* A piece of Timber at the end is 136 ſquare inches , what Timber in one foot in length. *An.* 5 foot ¾ in every 12 inches.

This Table is of Excellent uſe.

in.	Feet and Parts.
1	,00694414
2	,01388888
3	,02083333
4	,02777778
5	,03472222
6	,04166666
7	,04861111
8	,05555555
9	,06250000

800. 5.555
30. .208
6. .041
———
5.824

In the laſt figure upon the edge you have a Line called Timber meaſure, by which and the length of any ſquare Timber you may find the Content, thus inſtead of the ſide of your Timber in inch meaſure and parts, take that of this Line, aud multiply that by the length gives the meaſure.

The General Rule for meaſuring of Timber that is not ſquare at the ends, is to add both the ſides and take half, for the ſide of the true ſqu. but this is erroneous ; and ſo much the more as the

the sides are more unequal, therefore the Area of
the end is to be taken ; The other error is in mea-
suring round Timber by girding it, and taking over
quarter for the side of a square equal, but let it be
what it will, you must take such measures as the
Country useth.

Earth-work, as Cellars, Vaults, &c. are mea-
sured by the Yard solid, viz. 27 solid feet, and
so much ought to be a Cart Load, and will be con-
tained well ; the Carts ought to be 2 feet 8 inches
broad at the Axle-tree within, 2 feet high and 7½
5 long.

All Banks that are made to hold out the Sea
or Rivers , and all Ramperts , Parapets and
Motes , and New Rivers are wrought by the
Flore, consisting of 18 feet square and one foot
deep, which is 324 solid feet, which are 12 Car-

	X M.			M.			C.		
	f.	q.	f.	f.	q.	f.	f.	q.	f.
1	30.	3.	37	3.	0.	28	0.	1.	19
2	61.	2.	74	6.	0.	56	0.	2.	38
3	92.	2.	30	9.	1.	03	0.	3.	57
4	123.	1.	67	12.	1.	31	1.	0.	76
5	154.	1.	23	15.	1.	59	1.	2.	14
6	185.	0.	60	18.	2.	06	1.	3.	33
7	216.	0.	16	21.	2.	34	2.	0.	52
8	246.	3.	53	24.	2.	62	2.	1.	71
9	277.	3.	9	27.	3.	09	2.	3.	9

	F.	q.	f.
7000	21.	2.	34
800	2.	1.	17
57	0.	0.	57
	24.	0.	27

For measuring Ships, multiply the length of
the Keel, the breadth of the mid-ship beam, and
the depth of the Hold together, divide by 100,

it gives you the Tuns, or instead of the depth it
is usual to take half the breadth instead thereof:
But for Merchants that allow nothing for Guns,
Masts, &c. divide by 95. This may give a guess
at the Tunnage, but there is a great deal more re-
quired to give the true measure of a Ship, or the
burthen she will bear in salt water, for in fresh
water the ship will sink more.

To double a Cube, or to give the Cube Root
of a Cube that shall be double to another given,
double the Cubick Inches and parts of the Cube
given, Extract the Cube Root; and thus by
knowing the measures of the Ship of one bur-
then, to make another Ship of the same mould
which shall be double, treble, &c. or any pro-
portion more or less, multiply the measure of
the length, breadth, and depth, in solid feet, then
double, treble, &c. the feet, and extract the Cube
Root.

The next thing is concerning the solidity and
proportion in weight, several Metals, Minerals
and Water have one to another.

Note (4.) Concerning Metals, and of the ma-
nifold uses of the Table page 17.

1. If you have the magnitude of any body inso-
lid inches, and desire to know the weight of it in
Troy ounces: As, 1. is to the number of ounces
and decimal parts answering the Metal, Stone,
&c. in the Table A : : So is the Cubick Inches gi-
ven, to the ounces in weight required.

2. If you have two several bodies named in the
Table, both of the same magnitude or capacity,
together with the weight of one to find the weight
of the other : As the number in the Column A,
answering the first, to the number of the 2 : :
so the weight of the first, to the weight of the se-
cond.

3. The uses of the Column B are likewise

G   two

two : 1. To know the magnitude in inches
any Body by the weight in ounces ; As, 1. to
inches and parts in the Column of the Metal, &c.
proposed : : so the weight given. to the inches
magnitude. sought.

4. Two several Metals, Stones, &c. both
one weight, and the bigness of one in inches
say, as the number in Column B. standing agai
the first. is to the number against the second :
so is the magnitude of the first. to the magnitu
of the second in inches.

5. The uses of the Column C shews the wei
that every inch of the several bodies will wei
in water. From *Archimedes* we may say, th
all Bodies let into water, are either heavi
equal, or lighter, than so much water equal i
magnitude; if heavier then the body will sin
if equal then the bodies utmost surface will sin
even with the top of the water, if lighter th
so much of the body will sink into the water, i
as the quantity of water, which might be equ
in bulk to so much body as shall sink, shall wei
equal to the weight of the whole body put in
posed. Again, a body heavier than water, i
lighter in water when weighed, by the weigh
of so much bulk of water equal to that bod
Hence it is easie to discern the weights of sever
bodies in and out of water by the Column
and C, A is the weights in Air, C in wate
where it is plainly seen, that Gold being scan
the half quantity of Silver or Brass doth scarce b
half so much of its weights as Silver or Brass wil
and from this consideration *Archimedes* judg
of King *Hiero*'s Crown. By the Column C;
1. is to the number answering the body : : so
solid inches of any body given. to the weigh
water.

Now it will be convenient to give you the
Tabl

Tables for converting solid inches into weights of water Averd.

(1.)		(2.)	
		1,3,2356	
,579533		3,43112	
1,159043		5,17668	
1,738566		6,932,4	
2,318088	Averting Ounces	8,62780	Inches and parts
2,895611		10,35316	
3,477133		12,07892	
4,056655		13,80448	
4,636177		15,53004	
5,215699			

The first turns
solid inches of
water into oun.
Averdupois.
The second
turns ounces A-
verd. of water
into solid Inc.

Ex. In an Ale Gallon = 282 solid inches, how
many ounces Averdupois? by the (1.)

Answ. 163 oun. ,416 = 200. 115,90440,
to l. 3 oun. ,426 80. 46,361776
So in 300 oun. of wat. there is 2. 1,159,44
261,78 solid inch. by the (2) 163. ,416,

And in a foot solid there will be answering 1728
solid inches, 621. 9 oun. ,424,

The nearest proportion in Troy weight, that
96 solid inches will hold 19 ounces Troy of wa-
ter, and one pound Troy of water will fill 22,7,68
inches, and one pound Averd. 27,639: A foot
square of water is equal 76 pound Troy.

Hence is found a very good way for measu-
ring any Irregular body, that by no Mechanical
Art otherwise can be done. Fill any vessel brim
full of water, and then dipping in your body
receive carefully all the water that runs over,
and weigh it, and by the last 2 Tables turn that
weight into solid inches. Otherwise, if your
vessel be Regular that holds the water, observe the
rising of the water and find the solid feet or inches
answering.

Hence it is, that expert Builders of ships
have great consideration of all the premises in

this

this Section, for by the weight of the ship, and all appurtenances, they judg to what depth she will sink and herein the ingenious Sir *Anthony Dean*, one of his Majesties Commissioners of the Navy, has exercised abundance of skill, though for all the Art one can have, long experience and good judgment will be required, for as I had it from the said Sir *Anthony Dean*, that the proportion betwixt dryed Oak and fresh feld, is as 19 to 17; So that considering the strange forms of the Bodies of ships, and many such and more accidents, as that before of Oak wet and dry, it is a difficulty insuperable to give to an inch the depth a ship will draw when rigg'd and fitted out.

Lastly, if it be proposed to make a piece of Iron swim in pure water, you must make it so hollow that it may be capable to hold as much water, that will be equal in weight to the Iron and somthing more.

Note 5. Of Gaging of Vessels. The Gallon which is the grounds for this work, take as it is now allowed and used; Gallon for dry measure, is 272 solid inches; for Wine 231; for Beer and Ale 281.

		XM.		M.		C.	
		g. p. in.	g. p. in.		g. p. in.	p. in. p.	
Sol. Inches into Wine G.	1	43. 2. 09	4. 2. 18		0. 3. 130.		
	2	86. 4. 18	8. 5. 7		0. 6. 240.		
	3	129. 6. 27	12. 7. 26		1. 2. 111.		
	4	173. 1. 8	17. 2. 15		1. 5. 241.		
	5	216. 3. 17	21. 5. 5		2. 1. 9 1.		
	6	259. 5. 16	25. 7. 23		2. 4. 232.		
	7	303. 0. 6	30. 2. 12		3. 0. 62.		
	8	346. 2. 16	34. 5. 3		3. 3. 192.		
	9	389. 4. 25	38. 7. 20		3. 7. 53.		

	XM.	M.	C.	X.
	g. p. in	g. p. in	y. p. in	p. in
1	35. 3. 24	3. 4. 13	0. 2. 29	0. 10
2	70. 7. 13	7. 0. 26	0. 5. 23	0. 20
3	106. 3. 2	10. 5. 3	1. 0. 18	0. 30
4	141. 6. 26	14. 1. 16	1. 3. 12	1. 4
5	177. 2. 15	17. 5. 29	1. 6. 5	1. 14
6	212. 6. 4	21. 2. 7	2. 1. 0	1. 24
7	248. 1. 28	24. 6. 23	2. 3. 30	1. 31
8	283. 5. 17	28. 2. 23	2. 6. 24	2. 8
9	319. 1. 6	31. 7. 11	3. 1. 18	2. 18

Inc. into Beer and Ale G. 2

	XM.	M.	C.	X.
1	36. 6. 4	3. 5. 14	0. 3. 32	0. 10
2	73. 4. 8	7. 2. 28	0. 5. 30	0. 20
3	110. 2. 12	11. 0 08	1. 0. 28	0. 30
4	147. 0. 16	14. 5. 22	1. 3. 26	1. 6
5	183. 6. 20	18. 3 21	1. 6. 24	1. 16
6	220. 4. 24	22. 0. 16	2. 1. 22	1. 26
7	257. 0. 28	25. 5. 30	2. 4. 20	2. 2
8	194. 0. 32	29. 3. 10	2. 7. 18	2. 12
9	330. 7. 2	33. 0. 24	3. 2. 16	2. 22

Inc. into dry measure. 3

So that by these three Tables, if you cast up the Content of any Measure or Cask into solid inches, you may easily find the Gallons under g, Pints under p, and inches, either for Wine by the first, Beer and Ale by the second, and dry measures by the third. One *Example* for all :

In Wine, suppose 9845 inches, it will make 42 Gall. 4 Pints and 26 inches.

	g. p. in
9000	38. 7. 20
800	3. 3 19
45	0. 1. 15
	42. 4. 26

Thus for all Bushels, Pecks, and all other Measures in Cylinders, get the Area of the Circle in inches, and multi-

G 3   ply

ply it by the length, it gives the solid inches:
the Area, say, 1. 0 78539 : : so Dq. Area. or e...
ly by the Log : Add the Log : of the Diameter...
bled, to this Log : ³,895085, it gives you the A...
desired : But in measuring the Spheroid or R...
heads, and other Vessels so figured, as you...
taught before, you must take two thirds of the A...
of the Circle at the Bung.

Viz. 1. 0,5236 : : so Dq. to $\frac{2}{3}$ Area.

and 1. 0,2618 : : so Dq. to $\frac{1}{3}$ Area.

The Log. for two thirds is ³,718999. for 1...
³,417969 to be used as before.

If you will not measure by inches but...
Gallon Rod, you must take the Cube Roo...
272,25, of 231 and 282, which are 6,481...
and 6,557. and making scales of Gallon...
these measures taken from a Dia...
nal scale of an inch, upon your Ruler a...
and divide the same into 100 parts, so a...
Rod fitted to measure by Gallons, and 100...
Ex. A Vessel at the head by the Rod 3 g...
whose square is 9, at the bung 5, 5 whose...
is 30,25. say, as 1. 9 : : ,2618. 2,356 =...
of the Area. and 1. 30,25 : : ,5236. 15,839...
thirds of the Area at the bung, and 2,356...
839 = 18,145: Now 18,195x6,8 the length p...
ceth 123,73 that is 123 Gallons, and alm...
pints.

Here is a Printed Figure has all the three Li...
Wine measure. Beer and Ale measure, and...
measure ; the first two are one third of the A...
the last for Cylinders is the whole Area...
either edge is a Line of 8 inches, every Line...
to 10 parts, the scale is broken into 5 pa...
which makes 40 inches, by an *Example* it will...
plain.

A Ve...

A Vessel of Wine, at the head 18 inches, at the
bung 32 inches, length--40 inches.

I seek 18, I find it in the second row 1642, and
37 in Wine measure ; for a third against 32
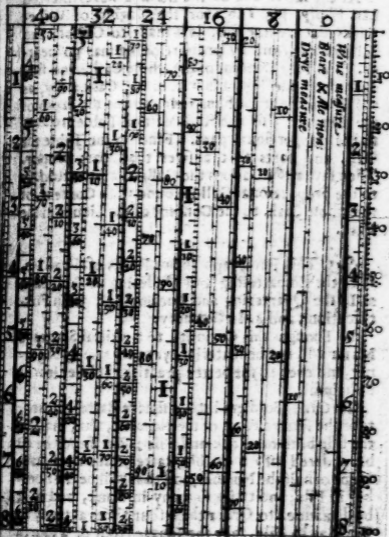
I find 1, 16, which doubled gives 2,32 ; now 337, 2,32 = 2,69 x 40 = 107,60, which is 107 gallons and half.

For Dry measure take the whole Area, because of Cylinders.

At the latter end of the Book I have inserted Mr. *Philips* his Table for the Gaging of Wine-Casks, that are not full, it is made to Gallons and half Gallons, and by proportioning may go nearer. Find the Content of the whole Cask, and find how deep the liquor is within the Cask ; say, as the Diameter at the bung in inches. to the depth of the Liquor : : so the Rad. of the Table 10000. to the proportional part. Find in the Table the Gall. and parts that answer that part propor. Then say, as 63 Gallons the Gallons of the Rod. is to the proportional Gallon found : : so Content of the whole Cask. to the Content of the Liquor in the Cask.

§. 5. This Paragraph shews Rules of Practice, 1. In the Embatteling and Ordering of Soldiers ; 2. In the Quartering and Encamping ; 3. In Fortification ; and 4. In Gunnery.

1. Though this Curiosity to a skilful Sergeant Major will not be material, yet to a young beginner, and even to the better practised Soldier it will be helpful.

To Order Soldiers into a square Battel of men, take the square Root of the Number, that shall be the side both for Rank and File : But if they be to be ordered into a double Battel, take the square Root of half the Number, and that will be the number in File, and twice so many in Rank, and if it be demanded to Order them four times as many in Rank as in File, take the square Root of a fourth part.

To Order them into a square Batt. of ground, you may distinguish them into Order and open
Order

Order---Order when the Centres of their places are diſtant 3 feet and a half in Rank and 7 in File, open Order when the Centres are 7 feet both ways. If it be a ſquare Battel of ground , and the Centre of their diſtances in Order ; then as 1, 2 ∷ ſo the Number of men to another Number whoſe ſquare Root is the Number of men in Rank : So by the help of extracting of a ſquare Root, theſe ſort of queſtions are eaſily reſolved.

9. For the Quartering and Encamping of Soldiers called Caſtremetation, it is requiſite the Quarter-Maſter General be skilled in meaſuring, and all the under Quarter-Maſters ought to be skill'd at Foot meaſure, that they may lay out their Quarters as directed.

Three hundred feet is the common allowance for the depth of ground that a Regiment whether of Horſe or Foot ſhould take up, the wideneſs muſt be anſwerable to the number of men. Two hundred feet for the Huts in length, and One hundred for the Commanders and Sutlers before them; every two Soldiers to a Hut, 8 feet broad and 8 deep, two feet one Hut from another , ſo that there may be 20 Huts ſtand in the 200 feet, the Alley betwixt Hut and Hut may be 8 feet, that is, 16 feet in width, and 200 in length for 40 men, which is 3200 feet, and for the 100 feet more 1600 feet, in all 4800, and there muſt be 25 Rows for 1000 men ; ſo that for a Regiment of 1000 Foot, with Officers and Sutlers, will take up 120000 feet, which by the Table aforegoing for turning feet ſquare, in Acres will be 2 a. 3 r. which becauſe of ways may be made 3 ac. of ground for every Regiment, which may be 350 feet deep , and 370 wide , or near 360 ſquare.

Now if 1000 Men, Officers , Sutlers , Highways and all, take up a ſquare of 360 feet, how many

many feet shall the side of a square be) to lodg
10000 Foot men, &c. say, 1000, 100000 : : 100
the square of 360 = 129600. to the square 1296000,
whose Root is the feet required, viz. 1138 feet,
which is very near thirty Acres of ground.

For quartering of Horse you must keep the
same depth of 300 feet for all, and take 100 feet
for the Huts, the Horse Huts must be ten feet
deep and four wide, twelve Horses will stand in
a Hut together, which is 48 feet long, and 40
wide, and 6 feet a street; the Huts for the
Troops will be 6 for 12 Troops, and so imagine
a Regiment consist of 8 Troops, 50 to a Troop,
it will take up, leaving 20 feet streets and cross-
ways, very neer as much ground as the Regi-
ment of Foot, ways and all 360 feet = 3 Acres,
so that ten Regiments will take up 30 Acres.
You may very well allow as much ground, as both
Horse and Foot will take, for the General, Train
of Artillery, Victuallers, &c. and parade places,
so that 120 Acres will well Camp 1000 Horse and
Foot, and all Provisions besides : From these
considerations you may be enabled to Encamp an
Army.

III. Note. Concerning Fortifications ; by a cu-
stom and use (neither great or small shot bringing
such danger as the Fear) Forts and Fortifications
are less considerable, and are taken in a short
time, therefore the late Engineers have thought
fit to lay open the Flanks, and to dispose their
Works, so as they may receive more Canon, that
the Enemy may be kept back from approaching so
fast, for all that can be done is to get and obtain
time.

I have not room to be large, you may peruse
Modern Fortifications Printed lately, and there
you may find several varieties.

I will set down these two Tables, and then

..., which are so short and plain, and will be at hand, that more shall not be needed, supposing the Reader already seen in the Rudiments of the Art.

First Table:

	Capital,	Gorg.	Flank,	Curtain.
	333:	200:	150:	600:

Sec. Tab.	Capital	4	5	6	7	8	9	10
Gor. Li.	398	437	367	333	312	300	291
	155	196	203	242	252	260	263

Both the Tables supposeth the Interior Polygon to be divided into 1000 parts. Then if you desire that the Flanks shall stand at right Angles with the Curtain, then by the first Table, if your Figure be an Hexagon, divide p p (*Fig.* 16.) into 1000 parts, make p = 333. p c, 200, and raising e f at right Angles to P P. make it 150, draw f a the Faces, and e c the Curtain, you may complete the work : But if you will not make the Flank at right Angles to the Curtain, but open it a little and have no second Flank, according to *Travaux de Mars,* set off the Capital and Gorg as before, raise the Flank at 98 degrees to the Curtain, and laying your Ruler on e, &c. draw the Faces.

Note that this proportion is ⅓ of the Interior Polygon for the Capital, and if you use ⅖ or ⅖/7 for the Gorg. and Flank it will be well.

The second way sets the Flanks at right Angles to the Lines of Defence ; For *Example*, in the (*Fig.* 17) Let it be an Heptagon, divide the side into 1000 parts, look in the second Table under 7, set off 333 for the Capital, and 242 for the Gorges , draw occult Lines from a to c, which are the Lines of Defence, and raise Perpendiculars from the points c, and draw c f for the Flanks, and f a for the Faces, this being well

understood

understood may be applyed likewise to Irregular Figures.

The fourth and last *Note* concerns *Gunnery*, or the Qualifications that Able Gunners ought to have.

First, He ought to have competent skill in *Arithmetick* ; to keep his Accounts fair, and to enter in his Diary all notable shots and occurrences in his Art, to be able to cast up the quantity of powder fit for each Peece, the weight of shot of all sorts, whether Lead, Iron, or Stone ; to work the Golden Rule in Proportions, to extract the Cube Root, which are formerly taught in this Book : He ought to have skill in *Geometry*, to take *Heights* and *Distances*, to know the Divisions of his Circle, Quadrant and Quadrate, to know how to Level, and to lay Platforms, and to raise Batteries, and though Ordinary Gunners may be excused from all this Knowledg, yet Master Gunners, and those that desire to be knowing in this Profession, must not hereof be ignorant.

He must know his Peece and Name which are taken from the height of the Bore, as in this Table annexed, which gives in the first Column the Name of the Peeces, next the weight of fortified Gun, the third the height of the Bore, the fourth the height of the shot, fifth, weight of the shot, sixth powder for proof, seventh, powder for serving, eighth, Paces (five foot to a pace) the Peece shoots point blank, or upon the Level : ninth, the utmost random the Peece mounted to 45 degrees, tenth the Horses, and eleventh, the men required to draw a Peece.

Names											
Can.											
Can.											
Dem											
24											
Cul											
12											
Dem											
Sake											
Mini											
Falcon											

No... Part... height... *Chamber*... inches... perm... those... are d... tal *Ring*... the d... the N... hole... as th... thick... nion... ken...

Names.	Guns weight.	Height bore.	Height shot.	Weight of shot.	Powder for proof.	Powder for service	Paces point blank.	Utmost Random.	Horses to draw.	Men to draw.
	C.			li.	lib.	li.				
Can. 8.	70	8	7.75	63	28	23	180	1800	18	100
Can. 7.	60	7	6.75	42	24	18	180	1800	16	80
Dem.C.	50	6.3	6.05	32	20	15	180	1800	12	60
24 l.	40	5.87	5.62	24	17	11	180	1810	10	50
Culv.	40	5.32	5.07	18	14	10	184	1840	8	50
12 L.	35	4.46	4.64	12	10,5	8	178	1780	6	40
Dem.C.	30	4.25	4.03	9	9	7	175	1750	6	35
Saker.	20	3.58	3.40	5½	5.25	4	160	1600	4	25
Minion.	12	3.35	3.18	4	4	3	120	1200	3	16
Falcon.	5	2.68	2.54	2½	2	1.5	120	1200	2	10

‘ Next he muſt learn from ſome Gunner the
Parts of a Peece of Ordnance ; the *Caliber* or
height of the *Bore* , the *Hollow Cylinder* , the
Chamber from the touch-hole to 2 feet or 18
inches where the powder and ſhot lye, the up-
permoſt part next the Breech is the *Baſe Ring*,
thoſe Rings from whence the Peece grows leſs
are called the *Freezes*, the uppermoſt of the Me-
tal or Freeze at the Mouth is called *Muzzle-
Ring* ; thoſe two knobs that hold the Peece in
the Carriage are the *Trunions* , the thickneſs of
the Metal is commonly meaſured at the Touch-
hole, the Trunions, and the neck : And all theſe
as the meaſure of Ladles , the length and the
thickneſs, and bigneſs of the Carriage, the Tru-
nions and many other things, were formerly ta-
ken from the height ef the Bore. He muſt alſo

H   be

be ready at all the Names about the Carriage of his Peece, *viz.* to know the Sides or Cheeks, the Axtree, Spokes, Nave, Hoops, Transomes, Bolts, Plates, Hooks to draw by, the Clout, the hole for the Linspin, the Shafts, the Thill and Thill-bolt, the Fore-locks and Fore-lock Keys, Cap-squares, the Fore-lock pins and Chain, the Pintle and bolt hole, the Fellows, Nayles, Bars over the Fellows, Stirrops, the Ruts of the wheel, Dowledges, Beds, Coines, Levers, Handscrews, &c. and to have ready his Ladles, Spunges, Cartridges, whether of Paper or Canvas, Formers of all sorts, Sheepskin to make Spunges, Powder, Shot, Needles, Thread, Starch, Marlyn, Twine, Nayles, Hand-spikes, Crows of Iron, Budg-barrels, Baskets, &c. These being the General things he is to know and have ready, he is in particular,

1. To *Tertiate* his Gun, that is to know the thickness of the Metal, at the Touch-hole, Trunnion and Neck, by which you judge at the strength of the Gun, whether well fortified or no, this you do with a Coliper pair of Compasses, and if the Peece be home bored, the Diameter less by the height divided by 2 is the thickness at any place, he must search his Gun for honey-combs with a searcher, or by reflection of a Looking glass, that the Trunions be well placed, that the Peece be neither top-heavy or otherwise, whether the Peece be bored away or no.

2. To *Dispart* his Peece, that is, to set such a mark upon the muzzle Ring or thereabouts, that a sight line taken upon the top of the Base Ring against the Touch-hole by the mark set at or near the muzzle may be parallel to the Axis of the Concave Cylinder. To do this, take the Diameters of the base Ring, and the place at the muzzle where you intend the Dispart to

stand, divide the Difference of these two into two equal parts, and one of them will be the Dispart, which set upon the Gun with pitch or wax, or which is the best way to frame a Dispart as you see in the Fig. (18.) and tye it about the neck of the Gun with ma lyn or twine: But if you have not Compasses measure the Circles about and work with them.

3. To be knowing in the weights of his shot, which he may do by knowing the weight of one; as a Bullet of Iron of 4 inches Diameter, is found by Experience to weigh 9 l. Say, as the Cube of 4 is to 9 l. : : so is any other Diameter Cubed, to its weight : or as 9 l. is to the Cube of 4 : : so is any other weight. to the Cube Root of its Diameter. Lead and Iron are in their weight near, as 4 to 3, that is, a shot of 4 l. of Iron, and a shot of 3 l. of Lead will have the same Diameter or height. Iron to Stone is as 3 to 8. Lead to Stone as 4 to 1, that is, a Bullet of Stone of 10 l. is equal in height to a Bullet of Lead of 40 l. Therefore knowing what a Bullet of Iron of any Diameter weighs, you may find the weight of a Bullet of the same Diameter of Lead or Stone, by saying, for Lead having the weight of 9 l. of Iron for 4 inches : 1∷3 give 2 : : what shall 9. 6 and for Stone if 8 give 3 : : 9 l. 3,37 ; and so of any other : if more exactness be required, seek for it in the Table of Metals, *Pag.* 17.

4. As the shot is regulated by the Cubes of the Diameter, so is the powder ; suppose one pound and half of powder be a charge for a Falcon of 2, 68 Bore or Diameter, what weight in powder will be fit for a charge of Cannon of 7. Say, as the Cube of 2,68. to 1,5 l. of powder : : Cube of 7 to 25.

The Logarithms facilitate this work, the Log. of 2,68 is 0.428135 × 3 = 1.28,4035 of 1,5. 0.176091. of 7 is 0.84508 × 3 = 2535294 now 0.176091 4

2535294 = 2 711385 — 1 284405 = 1 926980,
which is the Log. of 26,73, which is much above
the allowance.

5. To know whether his Peece be true bored,
the Master Gunner must shew him, for that is only
practise, by taking the differences of the Dispart
from a fitted Cylinder of wood for the Bore.

6. For the shooting in great Guns, and the know-
ledge of the true distance that any Peece will car-
ry to, is a matter that depends upon many uncer-
tainties, an exact answer will never be given to
such questions, there is such varieties in the true-
ness of the Bore, in the heights of the shot, in the
strength of the powder, in the Disparts, in the
levelling and direction, in the Air, Wind, &c.
But for all these difficulties an Able Gunner will
go near the mark, and he considers Point blank,
or Right Ranges, the Middle Ranges and utmost
Ranges; the former Table gives you the level
Ranges of each Peece, under the Title of Point
point Blank, five feet to a Pace, which is the best
distance for Batteries; the same gives you the ut-
most Random accounted near ten times the former
level Range; and for all other Mountures which
Gunners have agreed, which I shall not live to see,
take this Table to every six points of the Gunners
Quadrant for these Guns, viz. to 450.

	1	2	3	4	5	6
Cannon of 8.	750	1275	1,90	1710	1785	1800
Cannon of 7.	675	1147	1431	1489	1606	1620
Dem. Cannon	625	1062	1325	1425	1,87	1500
Culver.	750	1275	1590	1710	1785	1800
Dem. Culv.	725	1232	1537	1651	1725	1740
Saker.	625	1062	1325	1425	1487	1500
Minion.	450	765	954	1026	107	1080
Falcon.	550	935	1166	1254	1309	1320

For shooting in Mortar-Peeces which are elevated above 45 degrees and nearer to 90; you must use much practice to come to be perfect, after a shot or two be made you will be best able to judge how you must order your Gun, keeping still to the same powder, the alteration whereof will alter the shots Random, you may haue Tables in most Books of Gunnery, which you may prove and approve.

§. 6. *Problems* for Practice of *Plain* and *Spherical Triangles* upon the Sphere in Plano, with the ordinary Proportions thereupon, *Problems in Geography* and *Navigation* ; *Dyalling*, a *New Projection of the Sphere* ; *a particular Dyal*.

Prob. 1. Of these three, the length of a *Perpendicular* style upon an Horizontal Plain : 2 The length of the *Shadow* : 3. The Altitude of the ☉ above the Horizon, any two being given to find the third, see (*Fig.* 19.) Say, as in plain △s, as AC. AB : : Rad. cot of ABC the upper edge of the ☉ 4 15' the height of the Centre. Turn the Figure upwards, it is the same upon a vertical wall.

Prob. 2. Of these Three ; 1. The *Meridian. Alt.* of the ☉ or ✳ ; 2. The *Elevation* of the *Pole* ; 3. The *Declination* of the ☉ or ✳ any

two

two gi�, to find the third. For Alt. Equinoct (which is always the Complement of the heigh� of the Pole) ———— Merid. Alt. =Declination Sou or Merid. Alt. ——— Alt. Equi. =Declination N. The greatest Declination is found now constantly to be 23 deg. 30'.

Prob. 3, Of these Five: 1. The greatest Decl ⊙. 2. Longitude of the ⊙. from the next Equi point; 3. The ⊙ Right Ascension; 4. The Decl ⊙ in that place; and 5ly, The Angle of the Eclip ptick with the Meridian, any two being given to find the rest: For in (*Fig.* 20.) the △, γ ⊙ right ∠ at a, ∠ at γ is the first part in the *Problem*, γ ⊙ the second, γ a the third, a ⊙ the fourth, and the Angle ⊙ the fifth, any two being given, the other three may be found by the Rules for right Angl'd △s before taught. Note that the Longi-tude of the ⊙ and its right Ascension from the be-ginning of *Aries* are true in the first Quadrant, but must be substracted in the second Quadrant, and added in the third from or to 180°. In the fourth Quadrant must be substracted from 360.

Prob. 4. The Right Asc. ⊙ the hour of the day, the right Ascension of Mid-heaven, any two being given to find the third, for the right Asc. ⊙ 4 Time from Noon=right Asc. of Mid-heaven and Time from Noon=right Asc. of Midheaven — right Asc. ⊙, and right Asc. ⊙ right Asc. of Mid-heaven ——— Time from Noon.

Prob. 5. Of these Six: 1. Elevation of the Pole; 2. Decl. ⊙ or ✶; 3. Altitude of the ⊙ or ✶; 4. The distance of the ⊙ or ✶ from the Meridian; 5. The Azimuth of the ⊙ or ✶ from the North; 6. The Angle of the ⊙ or ✶ shew-ing its Position in respect of the Pole or Ze-nith, any three given to find the rest: For in the Oblique angled △, Z⊙ N. Z.N. is the com-plement

plement of the Elevation, the first; N ☉ the complement of Dec. the second, Z ☉ the complement of the ☉ Alt. the third : The Angle at N is the distance of the ☉ or ✳ from the Merid. ═ to the time of the day the fourth, the Angle at ☉ is the fifth, and at Z the sixth.

Prob. 6. Of these Five ; 1. The Elev. Pole ; 2. ☉ Decl. 3. ☉ Alt. at 6 ; 4. ☉ Azimuth. at 6 ; 5. The ☉ Position in respect of the Pole and Zenith ; any two given to find any one of the rest, for in the right Angled △ b Y c. ∠ at Y is the first, Y.b the second, b c the third, Y c the fourth, and the ∠ at b the fifth.

Prob. 7. Of these Five. 1. Decl. ☉. 2. Elevation of the Pole ; 3. The Amplitude of the ☉ rising or setting ; 4. The Angle of the Horizon and Merid. at the ☉ rising ; 5. The time from Midnight, any of these two being given to find any of the rest ; for in the right ∠ △ d N O , D N is the complement of Declination the first , N O the second, d O the Complement of the third, ∠ d the fourth, ∠ N the fifth.

Note, That the Angle at N or ∠ d N o , is the compl. of the Ascens. Diff. which might be found also more clearly in the △ Y f d , under the Hor.

Note, That the Ascensional Difference turned into time, by allowing for every degree 4′ of time sheweth how far the ☉ riseth from 6 a Clock, may be the time of the ☉ rising and setting.

Note, That if the Elevation of the Pole, and ☉ Decl. be both either North or both South, then the right Asc.——Asc: Diff. ═ obl. Ascension, and added ═ oblique Discension ; but if the Elevation of the Pole, and ☉ Dec. be the one North the other South, then add for the oblique Ascens. and substract for the Descension.

Note , For the Not-rising or Not-setting of certain Stars. 1. If the Elevation of the North Pole be greater than the Complement of the North,

North Declination , then that star setteth not, or
than the South Decl. then that Star riseth not ; and
if the Elevation of the South Pole be greater than
the Complement of the South Declination of the
star, then that Star setteth not, if greater than the
North Declin. then that star riseth not.

Note, That if you double the ☉ setting it is the
length of the day, ☉ rising the length of the night,
and half of that is the semi-diurnal Arch.

Note, Because the obtaining of the Hour and
Azimuth is very useful by taking the height of
the ☉, I will here set down an *Exam.* of them
both, after the manner of the last *Problem* in Spherical △s. In the Lat. 51. 30. the ☉ height 32°.
the Decl. 18°. first for the hour, then the Azimuth.

Hour.

```
Co. pole 38. 30. ar. si.  0.095850.
Co. Dec. 72. 00 ar. si.  0.021723.
        X--33. 30.
Co. Ht.---58. 00.
        Z--91. 30.
        X--24. 30.
Half Z   45. 45 sine 9.855096.
Half X   12. 15 sine 9.325699.
        Z  19.409368.
Sine 20°. 26'. half Z. 9.704684.
The hour 8 a Clock and one minute.
```

Azimuth.

```
Co. pole 38. 30. az. si.  0.095850.
Co. Ht. 58. 00. az. si.  0.071579.
        X--19. 30.
Co. Dec.---72. 00.
        Z--91. 30.
        X--52. 30.
Half Z --45. 45. sine 9.855096.
Half X--26. 15. sine 9.645706.
        19.778231.
        50°. 47'. half 9.889115.
The Az. 50°. 47. from the South,
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Note II. Of *Geography*, which is the knowledg of the Habitable World, and the measures thereof; first, you must know that the Latitude of any Place is the distance of it in degrees and parts from the Equinoctial ; the Longitude is the distance from the first Meridian placed by *Ptolemy* in the *Canaries*, but the most of the latest Geogr. place it in the *Azores*. From West to East the account is by degrees and parts, or by hours, accounting 15 degrees to an hour, and for every degree 4 minutes, and every minute 4 seconds.

The *Zones* are five ; 1. The *Torrid* Zone betwixt the Tropicks, two *Temperate* betwixt either Tropick and the Artick and Antartick Circles, and two *Frigid* from them to both the Poles.

The *Climates* and Parallels lye parallel to the *Equator*. A *Climate* is a *Zone* or Girdle that is contained betwixt two Circles parallel to the Equator, those Circles have the longest days differing half an hour, the middle Circle betwixt them has a quarter of an hour difference from the Extremes.

In respect of the shadows, the Inhabitants are differenced into *Amphiscii* , whose shadows are sometimes in a year round about them, East, West, North and South, being those that inhabit the Torrid Zone. *Heteroscii*, those that have their shadows one way as in the Temperate Zones. *Periscii*, those that in a day may have their shadows round about, as in the Frigid Zones.

In respect of the situation , the Inhabitants are *Periscians* that dwell under the same Meridian, and in one Parallel diametrally opposite in that parallel, they have the same Winter and Summer at contrary times, unless in the Frigid Zone ; *Antecians* dwell in like parallel from the Equator,

Equator, the one North, the other South, and un-
der the same Meridian and Longitude ; *Antipodes*
are those that are Diametrally opposite by the
Centre of the Earth : they have contrary Winters
and Summers, and days and nights contrary, being
out of the Torrid Zone.

The next thing is to consider the Maps, in which
of the World in General ; which have these Cir-
cles , the *Equinoctial* , *Ecliptick* , *Tropicks* of
Cancer and *Capricorn*, *Circles Artick and Antar-
tick*, *Meridians* and *Parallels*, such a Map
shews the Effigies of the Globe of Earth in
Plano, and in it you consider what places un-
North, South, East or West by the Meridians
and Parallels, and considering any Province or
place, you presently see how it is posited to the
North or South by its Latitude , to or from the
first Meridian by its Longitude , then in what
Zone or Climate, what is the longest day, La-
titude , Longitude ; and it is considerable that
Geographers make the right side of a Map the
East, the left West ; the North the highest, and
South the lowest parts ; next for the distance of
Miles , the *Italians* and *We* account fixty to a
degree, which would answer a mile for a mi-
nate , but it holds not true in either, for ac-
cording to Mr. *Norwood*, near 70 mile. *Engl.*
makes a degree, and in *Italy* at *Bononia* accord-
ing to *Ricciolus* 66 ; however let the account be
60 to a degree, and then to reduce those to *Eng-
glish*, say, as 6. to 7 : : so is *English* miles to
Astro. miles, and contrarily, as, 7. 6 : : so Astr.
miles. to *Engl.* How measures in Feet of most
Countries agree , you may find in the Table at
the end of the Book, Entituled , *Foreign Mea-
sures and Weights compared with the English*.
In all particular Maps you have a scale of miles
to measure the distance of places, if those pla-
lye within the opening of the Compasses, if they

ther, then by a Ruler turn the Compasses oftner about. The Globe of the Earth hath for its Superficies, Land and Sea, near the one equal to the other, the great Continents of *Europe, Asia, Africk* and *America*, are called the *Firm Lands* or *Continents* ; the rest are *Islands* rounded by the Sea, *Peninsula's* joyned only by a neck of Land to the greater, as the *Morea, &c.* I*sthmus* that very neck, *Promontory* high ground that juts out into the Sea.

Again, the Seas are divided into *Oceans* or Main Seas, and the *Mediterraneum*, or Midland Sea. A *Gulf* is part of the Sea, almost cut off, as the *Baltick* Sea. A *Streight* is the part cut off, as the streights of *Gibraltar*, these are the General Heads : And for a more particular practice, consider *Figure* 21. wherein N. is the North Pole, S. the South Pole, E Q part of the Equinoctial, A and B two places in the Northern Hemisphere, D, C two in the Southern, A B, A C, and D C are part of great Circles passing betwixt those several places ; Q B the Latitude of B, E A the latitude of A, both North, F D and C Q the Lat. of D and C South. ∠ A N B = ∠ D S C is the Difference of Longitude, of A and B or D and C, the ∠s N A B and A B N shews the position, how one place lies from another : Therefore first, if two places lye in the same Meridian, both on the North side of the Equinoctial ; as B and F : Q B being the Lat. of B and Q F of F, the difference of their Latitudes B F is their distance in degrees ; if one Lye on the Equinoctial, th' other not, as Q B the Lat. of B, is the Distance, if one have N. Lat. th' other South as B and C, the summ of both their Latitudes is their Distance B C. All which, and some other varieties, as being both upon the Equinoctial, are easily understood upon the Scheme.

And

And for more Exact Rules to know the Di-
stances, and positions of Places, consider the Tri-
angle A N B. there is six parts in this oblique
Spher. △. A N the Complement of the Latitude of
A, N B the Complement of the Lat. of B, A B
the Distance of A and B in a great Circle, ∠ A N
B the Difference of Longitude of A and B, the
∠ N A B the position how B bears from A, from
the Merid. towards the East, and the ∠ N B A
how A bears from B towards the West. Any three
parts of these six being given, to find any of the
rest, use the Doctrine taught before in oblique
Spher. △s. as if both the places be in South : Lat. as
B C it is the same with the former, if one be
North the other South resolve the △ N A C.
These Rules serve to find the distances and positi-
on of any two Stars after the same manner. The
△ C A B may by help of the former Rules be like-
wise resolv'd.

Lastly, To know how many square miles or
perches are in the whole Earth, or in any
parcel or part thereof included in a Triangle,
as A N B for the former, find how many square
degrees there are on a Sphere, whose circum-
ference of its greatest Circle is 360 ; say, by the
Rules before taught ; As, 7.22 ∵ : so square de-
360 (=119600.) to the superficies of the whole
Sphere in square degrees 4073 14. and suppo-
sing sixty miles in a degree , there will be 360
square miles in a square degree (though there is
more in the Curve) which gives 1466330400 square
miles in the whole ; but to reduce these to Eng-
lish miles : say , Q. 6=36. Q 7=49 : :
1466330400. to 1077303966. English miles by the
Back Rule.

But if it be a Spherical Triangle , as A N B,
or any other , as A B C, and it be required to
give the proportion of that △ to the whole
Sphere, according to Mr. John Leak's Rule, de-
monstrate

monstrated by Mr. *Foster*, add all the Angles of the Spherical Triangle together, from which subduct 180 deg. divide the rest by 720, it leaves the deg. and min. in proportion to 360 : : as that Triangle to the Sphere.

Note III. Of *Navigation*, which teacheth how and by what means a ship may be directed on the Sea to the Place or desired Port.

In short Passages, where you are but a small time without sight of Land, the Compass and knowledge of the Land and Sea-marks are sufficient : But in long Passages, where besides the Compass, Lead and Log-line, there are required Instruments to take the Latitudes, and to enquire after the Longitude and Distances : You may consider the same as one simple Course, or compounded of many : There are three ways of performing both Courses ; 1. By the *Plain Sea-chart* ; 2. By *Mercator's-chart* ; or lastly, by a *Great Circle*. The last is in part taught by the Rule in *Geography* last mentioned, of the distance and position of places, but is not practicable at Sea. The first may serve near the Equinoctial, but further off and in long Courses is false ; the second is true in all Courses, and ought to be most practised ; the first and second ways are practised alike in plain Triangles, the Difference only, that the Meridians are not equally divided in *Mercator's* way, but you must use the Table at the latter end of the Book, called, *A Table of Meridional Miles*, whereas in *Plain Sailing* all the lines are equally divided : The Practice will best appear by these few *Problems.*

Prob. I. To convert the *Rumbs* or points of the Compass into Degrees of Inclination towards the Meridian Line, and contrarily. The Mariners divide their Compass (which repre-

senteth

enteth the Horizontal Circle) into 32 parts,
called Rumbs; but far had it been better to have
used 360 degrees, to have been accounted from
both ends of the Merid. Line towards East and
West: But because this Division is not used, take
this Table, which will convert the points of the
Compass into degrees and minutes of the ∠ of In-
clination with the Meridian, and contrarily.

These on this side the West incline towards the N. end of the Mer.	Angle of Incl. with the Me. L.	These on this side of the East incline to the N. end of the Merid.
Rumbs.	North.	Rumbs.
North by West.	110. 15′	North by East.
N. N. West.	22. 30.	N. N. East.
N. W. by N.	33. 45.	N. E. by N.
North West.	45. 0.	North East.
N. W. by W.	56. 15.	N. E. by East.
W. N. W.	67. 30.	E. N. E.
W. by N.	78. 45.	E. by North.
West.	90. 0.	East.
West by South.	78. 45.	East by South.
W. S. W.	67. 30.	East S. East.
S. W. by W.	56. 15.	South E. by East
South West.	45. 0.	South East.
S. W. by S.	33. 45.	S. E. b. S.
S. S. W.	22. 30.	S. S. East.
S. and by W.	11. 15.	S. by East.
Rumbs.	South.	Rumbs.
On this side West incline towards S. end Meridian.		These on this side East incline with S. end Merid.

If you account to quarter of points add 2°. 48'. for one quarter : 5°. 37'. for two quarters , and 8°. 26'. for three quarters.

Prob. II. A ship sailing under a great Circle, to know how many *English* miles answers the degrees: If it sail directly N. and S. it is under the Merid. if E. and W. under the Equinoctial ; say , 1 degree. give 70 miles : : degrees gone. gives the *English mile.*

Prob. III. A ship sailing under any Parallel, to know how many *English* miles answer to the number of degrees in that Parallel ; say, as, Rad. sico: Lat: of the Parallel : : so is number of the degrees in that Parallel. To the number of great Circle degrees, which turned into miles gives the Answer.

Prob. IV. The *Rumb*, the *Distance* upon the Rumb in miles (60 to a degree) the *difference of Latitude* in miles , the *difference in Longitude* in miles, any two of these given, to find the other two : : in a plain right ∠d △. (see *Fig.22.*) Where A is the place from whence the ship sails , the Rumb N E by N. therefore the Angle of Inclination B A C by the Table is 33. 45. its Complement BCA 56. 15. C the place to which the ship is to sail , A C the distance in miles , 909 miles , A B is the difference in Long. 853 miles ; B is in Latitude 59°. 36' ≥ A. C in Lat. 47°. therefore A C is 8;6 miles , this is according to the plain Sea Chart ; but according to *Mercator*, you must find the distance A C by the Table of Meridional miles, thus, use the same directions given in the *Note* for Geography, the places being both on one side of the Equi. substract the Merid. miles answering 470. viz. 3202 from the Merid. miles answering 590. 36'. viz. 4480 rest 1278 miles for the distance A C. This being the only difference in these two kinds of sailing, and thus observed the Resolution of this

I 2.   △ will

△ will perform all simple Courses ; and if it be
compounded of many Courses you must so many
times multiply your Operation.

Note IV. Concerning Dyalling. To make an
Horizontal Dyal, you must calculate the distan-
ces on the Horizon from the Meridian to each
hour, half hour, and quarter by this Rule; As,
Rad. to sine of the Latitude : : so Tangent of the
Equi. hour from Noon. to the Tangent of the Hor.
Distance from the Meridian, of that hour, half or
quarter.

If you desire to calculate for every minute,
then you take every minute of the Equi. hour, as
for every quarter, then begin with 3°. 45'. 7°. 30'.
&c. 15. and 15 for an hour, &c. To make a Dial
for a full South Wall is the same with the former,
only changing the sine of the Latitude, to the Co-
sine.

For a declining upright Plane, you must first
find the Angle of the *Meridian* and *Substile* thus,
as Rad. Co. tan. Lat : : sine Declination. tang. height
desired : secondly, the height of the Stile above
the Substile ; thus, as Rad. Co-i. Decl. : : Cosine.
Lat. to the sine of the height desired : thirdly, the
difference between the Merid. of the Plane and
Place ; as, si. Lat. to Rad. : : so tan. Decl. to Tang.
desired. Fourthly and last, you must find the
Angles which the hour-lines make with the sub-
stile line, which is the Merid. of the Plane ; as
Rad. to si. of the stile height above the Plane : :
so is the tangent of the hour line from the Merid.
of the Plane. to the tangent desired. For a Merid.
Dyal, where the Plane looks full East or West,
the hour lines are all parallel to the line that pas-
seth from Pole to Pole, which is the hour of six;
then say, as Rad. to the height of the style in any
known parts of a scale : : so is tangent of any hours
distance from 6. To the distance thereof in the
same parts.

Now

Now for a Mechanical way, to make any Dyal, to any Plane whether declining, reclining, or inclining, crooked, bended, or any ways uneven, without any notice taking of any such declination, reclination, &c. by the help of a large and good Horizontal Dyal, which must have a small hole in the Centre to suffer a silk thred or hair to go through : you may work thus, under the Plane, where you intend to make a Dyal draw a *Level Horizontal Line*, by any Carpenters or other Level, to this line set a Scaffold or frame of any boord or boords deep according to the bigness you intend the Dial to be ; this scaffold must be level likewise.

This being fitted, and by any other true Dial, Equinoctial Ring, or by the height of the ☉, your minute Watch rectified or otherway, find the true time of the day, and placing your Horizontal Dyal upon the level Plain, keeping it to the true time of the day, by removing it to and fro, you may by the thred from the Centre, carried by the edge of the Gnomon, find out the Centre of the new Dyal, if it will have a Centre, which mark, and by small tacks fasten your Horizontal Dyal in that place, that it may not move, the thred or hair carried by the edge of the Gnomon if continued into either Pole, and is the Gnomon to the new Dyal, the perpendicular Line under it taken by a square is the substiler, and the stile may be fastned to the Plain, by help of that thred.

Now to draw the hour Lines, do this, lay the thred fixed to the Centre of the Horizontal Dyal, over the hour lines and quarters, and mark out in the Horizontal Line on the plain where they intersect, Lines drawn from the Centre of the new Dyal to these points are the hour Lines : But some hour lines may run off the Plain, or by reason of the crookedness, or some Pillars

may

may hinder; to help this, draw as large a squar[e]
or oblong upon the Horizontal Plain as you ma[y]
and transfer (by help of the Centre thred) all th[e]
hours from the Horizontal Dyal, into the Lines [of]
the outside of the said square or oblong; now [if]
you bring a thred from the Centre of the new Dy[a]
al, and rest it upon the hour points marked i[n]
the said square, the Centre thred of the Horizon[tal]
tal Dyal carried only to touch the other thre[d]
will describe the hour line desired, whether upon
an even or uneven Plain that have Centres for the
new Dyal; but if the Line carried by the edge[s]
the Gnomon of the Horizontal Dyal will no[t]
meet with the Plain, as in all East and West Plai[ns]
much declining, then must you fix up a Board o[r]
other matter to receive the Centre by the sid[e]
of the Plain, and then fixing a thred there b[y]
that, and the other thred you may strike all th[e]
hour lines, as was before shewed in crooked
Plains, and the thred from the Centres being th[e]
new Gnomon, must be fixed to the Wall by tw[o]
stays.

This may be practised with as much curiosity a[s]
any other, and will be sure and exact.

Note V. *The Description and use of an Univer-*
versal Dyal for all Latitudes, being a Projecti-
on of the Sphere in Plano, presented to his Roy[al]
Highness, *Anno* 1665. for his Particular use [at]
Sea.

One *Hemisphere* being circumscribed by a Cy-
linder, wherein the Equinoctial and Cylinder
touch, let the Hemisphere be conceived so t[o]
extend from the Equinoctial, that the two co[l]
lures, and all the Meridians may touch the Cy-
linder in the Tangents of the Degrees and Mi-
nutes of the Meridians, all the Meridians wil[l]
be streight Lines, all the Parallels Circles distant
from one another as their Tangents; and for
particular uses, let the Hemisphere have upon the
                                    Intersecti[on]

Intersection of the Equinoctial Colure and Equinoctial *Semicircles*, at each degree distance.

These, as likewise the Ecliptick, and all other Circles described from that point will be Ellipses on the Cylinder: Having this Cylinder thus furnished, laying it upon a Plain, so that the Equinoctial Colure may touch the Plain, let this Cylinder be *Orthographically*, or *Perpendicularly* projected on that Plain: so have you the Dyal or Hemisphere now before you, the demonstration whereof will be too tedious for this place. The description thus: the point of ♈ and ♎ is the Centre, the uppermost Line divided both ways into 90 degrees is the Equinoctial, the Line ♈ o that goes at right Angles down is the semicircle of the Equinoctial Colure, the two edges are the Solstitial Colures, and stand for the Meridian of 12 a Clock, all the streight Lines from top to bottom are the Meridians or Hour Lines to every quarter of an hour, 15° of the Equinoctial above being an hour; the Meridians on both edges are numbred from the Equinoctial to the Pole, and from the Pole to the Equinoctial to 90°. The Parallels to the Equinox are drawn through every degree of the Meridian, and are so numbred both on the edges and on the middle being the Axis of the Sphere, upon the Quadrant on the left hand are drawn several Elliptical Lines, which represent the Circles formerly spoke of described upon the Centre, being the point of East and West to every two degrees. The Ecliptick is drawn both ways from the Centre ♈ and ♎ declining 23° 30' upon the Merid. and divided into Signs and Degrees by those Elliptick Lines.

The back-side of the Instrument has many Uses shewed in the beginning of the Book: those of this Projection follow.

Use 1. Having the ☉ place to find his Declination,

nation, right Ascension, or by either of these to find the ☉ place.

First, Find by the day of the month on the back side the ☉ place, which seek in the Eclipti.k, the Parallel that passeth by that place, shews the ☉ Declination, and the Meridian the ☉ right Ascension in the Equinoctial ; so likewise the Declination or right Ascension given shews the ☉ place.

Use 2. To rectifie the Centre Thred to shew any Horizon, or any Line of East or West which passeth to the Zenith, or any Inclination to the Horizon or Equinoctial, that any point upon the Hemisphere shall make with the Horizon. The Centre Thred laid to the Latitude of the place on the left hand in Summer, or on the right hand in Winter, will represent the Horizon of that Latitude by the greater figures which come numbred from the Pole. And if you lay it to the Latitude from the Equinoctial numbred by the smaller Figures on the right hand in Summer, or left side in Winter, it represents the Line of East or West, and the point in the Meridian shews the Zenith. Or any point upon the face being set by the Parallel and time of the day, laying the Centre Thred thereto, it shews on the edge how many degrees it inclines or declines to or from the Equinoctial, and that being added in all Northern Signs, or subtracted in Southern to or from the Equinoctial height (which is always = to the Complement of the Latitude) it gives the Inclination or Angle a great Circle passing by the point given, makes with the Horizon.

Use 3. To know the time of rising and setting of the ☉ the Ascensional Difference, the amplitude,

amplitude, and the length of the day or night.

By the last *Propofition* lay the Centre Thred to the Meridian for an Horizon, whereever the ☉ parallel cuts it, amongst the hour lines, it gives the ☉ rifing and fetting, and the Elliptical Line which paffeth by that place gives the amplitude or the diftance in degrees from the Eaft; the Meridian of the ☉ rifing carried to the Equinoctial fhews the Afcen. Diff. in degrees; laftly, double the ☉ fetting for the length of the day, and rifing for night.

Ufe 4. To find what time the ☉ will come Eaft or Weft, and what height the ☉ fhall have at that time. By the fecond *Propofition*, lay the Thred to the Latitude told from the Equinoctial in the edge on the contrary fide to the Horizon, that is the Line of Eaft and Weft, and following the ☉ parallel to that Line, the point where the inter-fection fhall be amongft the hours gives the time, and among the Ellipfes the ☉ height at that time.

Ufe 5. To know the height of the ☉ at fix a Clock and the Azimuth, or diftance the ☉ fhall have from Eaft or Weft. Follow the ☉ parallel to fix a Clock, the crooked lines fhews you the ☉ height; and laying the Centre Thred to the point of Eaft or Weft, mark where the parallel cuts it, and and follow the hour line to the Equinoctial (which now fhall reprefent the Horizon) the diftance from the Centre is the Azimuth.

Ufe the 6. To find the ☉ height at any time of the day: Setting the Horizon right find the point of the ☉ rifing, fetting one point of the Compaffes there, extend the other to the Zenith, and by a black lead point make an Arch

that

that shall end upon the hour of the ☉ rising, the
Degrees of that Circle, cut by the hour lines shew
the ☉ height.

Use 7. To rectifie the Hook, Bead and Plum-
met : At the end of the Hook (which by his
skrew may be moved at liberty) there hangs a
Thred and Plummet with a moveable Bead,
the very end of the Hook from whence the Plum-
met hangs , must be skrew'd fast to the place
where the ☉ riseth on the Horizon , and the
Bead must be set to the Zenith on the contrary
side.

Use 8.   To find the hour of the day at any time
the ☉ shining ; after the Hook and Bead be rec-
tified , as is set down in the last use , lift up
the Instrument (, so that the Bead and Plum-
met do freely play) that the ☉ may shine
through the least sight upon the other, the Hook
shews the time of the day amongst the hour
lines.

Use 9.   By the ☉ height or hour to know the
☉ Azimuth.   By the second *Use*, observe where
the Meridian of the ☉ hour and the Parallel meet,
and thereby on the side find the Inclination of
that point to the Horizon, where lay the Thred,
then by the *Use* 6. find the ☉ height , now let
the Equinoctial represent the Horizon, and so
counting the height amongst the Parallels, where
that Parallel crosseth the Thred laid to the Incli-
nation, follow the Meridian to the Equinoctial,
the number from the Centre is the Azimuth from
the East.

Use 10.   All the former *Propositions* may be
applyed to the Stars , remembring the ☉ shew
the hour , therefore use the right Ascension

the ☉, which take from the right Ascension of the Star (if it be bigger, if not add 24 hours) rests the time of that Stars coming to the Meridian ; and if you know the Stars hour before midnight, take it from the time of the Stars Southing. If after add it, you shall have the true time of the night. These excellent uses you have from this Instrument, sold if you desire it, with the Book : If you desire it of Metal and Larger, Mr. *Marks* before mentioned will make them, or Mr. *Hays* in *Moorfields*. Lastly, upon the inside of the Cover you have a particular Dial will serve within Thirty Miles from *London* presently to know the hour of the day, the Parallels up and down answers the days of the Month, the other streight lines that are parallel, shews the ☉ height, and whereever that crosseth the other, there is the hour, the long hours for Summer and short ones for Winter, and placing a pin in the point *VI*, letting it shade in the Line *VI. IV.* a Line and Plummet playing from it will shew the ☉ height on the right side.

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§. 7. Of the Nature *and making of* Watches, Clocks, *and other* Movements, *Collected from* Mr. *Oughtred's* Automata, *with several Additions and Notes about* Pendulums.

THe great Wheel whereon the Fusie or string with weights are fixed, divides the Nature of the Work in any *Movement*, that is, all the Wheels and Pinions from that to the Ballance or Fly only prepares the Motion, but the other way effect it. Things to be Noted are,

3. The

1. The Fusie, and how many turns it hath.

2. The number and names of the Wheels, Teeth, and Pinions, viz. in a Watch of four Wheels (supposing the Numbers annexed to be the Teeth) first the *Great Wheel* (Number 55 Teeth) turning the *Pinion* (Numb. 5.) fixt to the *second Wheel* (N. 45.) turning the *Pinion* (N. 5.) fixt to the *Contrat Wheel* (N. 40.) turning the *Pinion* N. 5.) fixt to the *Crown Wheel* (N. 17.) having odd teeth, working upon the *Pallats* of the Ballance (N. 2.) But in Watches of five Wheels there will be a third Wheel before the Contrat Wheel.

3. The *Pinion of Report* fixt to the Arbor of the great Wheel (N. 4.) which lies hid betwixt the Plates in Watches, and turns the Hour Wheel (N. 36.) which carries the hand about upon the Face divided into 12 or 24 hours,

For brevities sake, let M. stand for the Movement whether Watch or Clock, F. the Fusie. A the great Wheel, *a* the Pinion of report on its Arbor, E the second Wheel, *e* the Pinion on its Axis, I the Contrat Wheel, *i* the Pinion on its Axis, O the Crown Wheel carrying *o* its Pinion on its Axis. B the Dyal Wheel carrying the hand, is H hours, T time, *t* turns, N Notches or Beats of the Ballance. Con. Continuance and length in time of the Watches going.

The Work will stand both in Letters and Figures, as in the *Example*:

$$a)\ B\ (d\ \ 4.)\ 36\ (9$$
$$e)\ A\ (f\ \ 5.)\ 55.\ (11$$
$$i)\ E\ (g\ \ 5)\ 45.\ (9$$
$$o)\ I\ (k\ \ 5)\ 40\ (8$$
$$o\quad\quad\quad 17\ \text{Crown Wheel.}$$
$$\underline{\quad\quad\quad 2\ \text{Pallats.}}$$

where

where every wheel is divided by the Pinion it moves from A to O. *viz.* 55 by 5=11= f. 45 by 5=9=g. 40 by 5=8=k. But B divided by a gives 9 that is B by a=d.

1. *Rule.* f g k O 2=11 x 9 x 8 x 17 x 2=26928. equal to N. Notches or Beats made in one turn of the great Wheel, and 26928 x 9=242352 the bears that are made in one turn of the hand, whether 12 or 24. Lastly, divide 242352 by 12 it gives the Beats in an hour, 20196. and by 60 gives the Beats in a minute, 336,6. Thus far I question not, is very plain, and must be practised to be well understood, as being the Foundation of the whole work; and by it you may easily know how many turns any Wheel or Pinion makes for one turn of the Fusie or hour wheel.

2. *Rule.* As the Beats for one turn of the great Wheel or Fusie ———————— 26928

  Is to the Beats gone in one hour ———— 20196

:: So continuance of the Watches going——— 16

  To the number of the turns about the Fusie ————————————————— 12

:: And so are the hours of the Face ———— 12

  To the Quotient of the hour Wheel divided by a. ——————————————— 9

These proportions holding, that any three given, (not the same kind,) you may find the fourth: As for *Example,*

To know the continuance of the Watches going, that hath 12 turns in the Fusie, and 26928 Beats in one turn; and 20196 Beats in an hour. Say, N in an H. N one t F :: 12 r. of F. to Con. 20196) 26928 x 12 (16. But if it be demanded by the Beats, and the time of the Watches going to know the Turns of F. 26928) 22156 x 16 (12. Or if it be demanded what Quotient shall be laid

K   *upon*

upon the Pinion of Report ; Say, 16. 12 :: ½,
9 ¾ or as 26928. 20196. Note that the leſſer 8 ¼
taken, the longer ſhall be the continuance of the
Watches going at an equal T.

Rule 3. Concerning *Pendulums*. The ſpring
in a Watch, drawing harder at the firſt than at the
laſt ; and likewiſe in Clocks with weights and
ſtrings, there is added the weight of the ſtring
gotten every moment, to the Clock weight, and
for that no Motion can by hand be made ſo fit, but
there will come ſome unequalneſs, as you may
hear by the Beats either of Watch or Clock, to
juſten and regulate theſe inequalities *Monſieur*
Hugens invented the way of applying *Pendulums*
to either, for which his Name will be ever Re-
membred.

Pendulums, whoſe Vibrations are of the ſame
Degrees and Minutes are equal, or if they riſe not
above a Degree, and the ſquares of their Vibra-
tions are in proportion to the lengths : For a
Standard or Rule Monſieur *Hugens* gives the length
of a *Pendulum* that ſhall ſwing ſeconds, to be 864
to the *Pariſian* feet 864. The *Engliſh* Feet to the
Paris feet by my Table are, As, 1000. 1068. There-
fore, 864. 881 :: 1.068. 1.089 and 1.089 × 3 =
267 equal to three feet three inches, and two tenths
of an inch.

The Honourable Lord *Bruncker*, and Mr. Rook
found the length to be thirty nine inches and ⅕
parts, which a little exceeds the other, and may
be, was juſtned by Maſter *Hugens*'s Rule for the
Centre of Oſcillation ; for *Montous Pendulum*
that ſhall vibrate one hundred thirty two times in
a minute, it will be found likewiſe 8,1 inches a-
greeing to 39,2 inches *Engliſh* : Therefore ſome
certain 39,2 inches may be called the univerſal
meaſure, and relied on , to be the near length of
a *Pendulum* that ſhall ſwing ſeconds each vibrati-
on : With this caution and Rule , As the length

of the string from the point of suspension to the Centre of a round Ball. is to Radius : : so is Radius, to a fourth number. Let two fifths of that fourth be added to the former length, for the length of the *Pendulum*. Having this Standard, the next Rule is this : That the lengths of two *Pendulums* are in proportion to the squares of their several vibrations, which will be equal to the Beats of the Ballance ; therefore the Beats that shall be proposed in a minute, being given to be 50, and it be demanded to give the length of a *Pendulum* ; Say, as the square of 50. (2500) is to the square of 60 (3600) :: so is 39,2 to 56,4 the length required for (2500) 3600 × 39,2 (56,4.) And if the length be given to know the swings or beats in a minute, As Altitude given, To Altitude known :: so square vibr: known. To square vibr: req. whose square Root is the Answer : And because the two middle terms stand in all such Questions, and will be always 141120 : Therefore divide 141120 by the square of the swings in a minute, it gives the length sought ; or by the length it gives the square of the Swings. And thus as the Ingenious Master *Hook* first proposed, I have hang'd a swing by my Clock to regulate it upon a Pin, that it may freely vibrate.

$$48) \cdots 4 \ (12$$
$$56 \cdots 7 \ (8$$
$$54 \cdots 6 \ (9$$
$$21$$

The numbers of the great wheel 56, its Pinion 4 turning the hour wheel 48. The great wheel turns a Pinion of 7 fixt to the Crown wheel 54, which turns a Pinion of 6 fixt to the Ballance wheel 21. The Quotients $8 \times 9 \times 21 \times 2 = 3024$ the beats in an hour, because the great wheel turns once in an hour, else $12 \times 9 \times 21 \times 2 = 36288$.

12) 36288 (3024 and 60) 3024 (50,4 beats in a minute, and as was shewed before, the length of the *Pendulum* will be 55, 5 inches, fix a weight upon a wire running into a Rod, that shall have four feet 7,5 inches below the Pin whereon it plays, and about a foot or above, a wire beaten flat with several holes to fit to the top of this Rod, and to a Pin placed upon the Ballance towards the back side, will regulate the Motion exceedingly well, and may be done without trouble or charge.

For the regulating the inequality of a swing, when it may rise sometimes higher, sometimes lower : There are two ways, either by making the Line play betwixt two Cheek parts of a Cycloid, as Monsieur *Hugens* has directed, which may easily be effected to any length of the *Pendulum*, and are made, if any desire them, by Mr. *Humphrey Adamson* near *Turnstile* in *Holborn*.) Or else by not suffering the *Pendulum* to vibrate above an inch from its settlement : For my part, after some time and charge of Experiments, I believe the first the better way. Monsieur *Hugens* in his Book of *Pendulum* Clocks, proposeth a Watch about a mans height, to go 30 hours, and to have these numbers.

```
    D   B
    6——72
 a 30-30 a
A 80-8.-- (10
 E 48.8.. (6
 I 48.-- 24 (2
     O 15
```

The great wheel 80, &c. which turns about in an hour, and shews minutes ; therefore for an hour multiply the Quotients. 10 x 6 x 2 x 15 x 2 = 3600 being the seconds in an hour (60 x 60=3600) or beats. Now the third wheel I turns about in one minute for 10, 6=60, and carries a plate divided into 60 seconds, and shews the seconds ; and upon the Arbor of the great wheel is fixed a wheel a turning another wheel a, both of 30 teeth, both turning about in an hour ; the latter has on it a Pinion b of 6 teeth turning

turning B 7½ in 12 hours. This Watch has a pully tyed to its weight, by which you may pull it up and not stop the Watch ; the *Pendulum* plays betwixt two Cheeks, part of a Cycloid.

The next question (supposing there be a screw below or above the *Pendul.* to lift it up or let it down upon a squ. brass Ruler divided into inc. and tenth parts) to know how many minutes and seconds every tenth part of an inch will make the Watch go faster or slower in a day. I take the *Pendulum* which swings seconds length 39,2. Then by the Log. I make this Table.

I	II	III	IV	V
38,7	1.587711	1.780988	60;39	9. 21
38,6	1.588832	1.780378	60;31	7. 26
38,9	1.589949	1.779819	60;23	5. 31
39,0	1.591065	1.779261	60;15	3. 36
39,1	1.592177	1.778705	60; 8	1. 53
39,2	1.593286	1.778151	60.	1. 11
39,3	1.594393	1.777597	59.92	1. 55
39,4	1.595496	1.777046	59.85	3. 36
39,5	1.596597	1.776495	59.77	5. 31
39,6	1.597695	1.775996	59.70	7. 26
39,7	1.598790	1.775399	59.62	9. 21

The first Column has in the middle the length of the *Pendulum* 39. 2 inches, upwards it diminisheth one tenth, and downwards increaseth one tenth.

The second Column are the Log. of the first.

The third Column are half of the Log. of the difference of the II taken out of the Log. 5.149588, which is of the standing number 141120 aforesaid : The *IV.* Col. are the numbers of the *III* ; and the *V* Column are the minutes and seconds that these augmentings or diminishings will cause in a day, and are gotten by Multiplying 24 x 80 = 1440 the

K 3   minutes

nutes in a day, by the decimals above or un
60''. which work may be done easily to any len
of a *Pendulum*.

Rule 4. Of finding out fit Numbers for th
Wheels and Pinions.

1. Any two Fractions, whose Terms are pr
portional perform the same Motion; a
$\frac{9.\ 36.\ 45.\ 63}{14\ \ \ 5\ \ \ 7}$ &c. The upper for the Wheel
the lower for the Pinion.

2. If it be as one Wheel. to one Pinion;
so is the product of many Wheels. to the pr
duct of many Pinions, both will perform th

same Motion. *Exam.* $\frac{1440}{28}$ equal to $\frac{36}{28}$

$x \dfrac{5}{1}$ or $\dfrac{36}{4} \times \dfrac{8}{7} \times \dfrac{50}{10}$ for $\dfrac{36 \times 8 \times 50}{4 \times 7 \times 10}$

$\dfrac{14400}{280} = \dfrac{1440}{28}$ nor matters it in what order th
Wheels and Pinions are set, or which Pinion sta
under every wheel.

3. These Factor's 36×8 given, may thus be va
ried, viz. Divide them by such numbers as wi
measure them, and multiply the Quotients b
the Altern Divisors, the Product of 9.
those two last numbers shall be two $36.$
to the Product of the Factor's given. for $4.$
$36 \times 8 \_ 32 \times 9 \_ 288.$ $32.$

4. If fit numbers cannot be had by
any of the three former ways, you must seek som
Ratio as near as possible in this maneer, as on
of the two Numbers. is to the other : : so is 36,
to a 4th. Divide that 4th number, and also 36,
by 4, 5, 6, 7, 8, 9, 10, 12, 15; or which
them bringeth a Quotient nearest to an Integer;
as if the two Numbers be 147. 170, which are too
great

great to be cut into wheels, and yet cannot be reduced into less, because they have no greater common measure than Unity.   Say therefore,

170. 147 :: 360. 3114 ⁶)³¹¹⁴(⁵²· ⁸)³¹¹⁴(³⁹·
147. 170 :: 360. 415.4)360(60   )360(45.
⁸) ³⁶⁰(⁴⁵
  416(52| 147 and 170, you may take 52
and 60; 39 and 45, or 45 and 52.

Rule 5. The Diameter or Circumference of any wheel given in inches and one hundred parts, and the number of teeth it is divided into, to give the Diameter or Circumference of a lesser Wheel or Pinion, with a number of teeth given that shall exactly agree with the teeth of the greater Wheel : *Exam*. The great Wheel has one inch Diameter, and fifty teeth, the lesser Wheel or Pinion ten teeth; say if 7. 22 :: 1. 3, 14; then if 50. 3. 14 : : 10. 63 for the Circumference of the Pinion, whose Diameter will be ,2 of an inch.

Rule 6. To give Numbers to a Watch that shall have a swift train, about 20000 beats in an hour, that may have turns about the Fusie, and go 16 hours, and the number of the Crown Wheel 17. Say by the second *Rule* 12. 16 : : 20000. 26666. the Beats for one turn of the Fusie; and because by the first *Rule* 26666 is equal to all the Quotients multiplyed together into 17 and into 2, that number being halv'd is 13333, and that again divided by 17 gives for the Quotient 784, which being broken into three numbers, that multiplied together will be 784, or near to it; let them be 11. 9. 8. multiplied are 792. Then 792 x 17 x 2 = 26928.5 and say, 16. 12 : : 26928. 20196 the Beats in an hour. Also 16. 12 : : 12. 9 and

$\frac{9}{2}=\frac{36}{4}$. Lastly, by the three Quotients assured

11. 9. 8 find out the 3 Wheels and Pinions, by taking the Pinions as you desire, as is done in the side: You may try several Experiments to make the Watch go longer by altering the Beats and Pinion of Report.

4) 36 (9
5) 55 (11
5) 45 (9
5) 40 (8
    17
    2

Examp. Of a Clock or Watch proposed to go a week or 8 days with this Order, that the Ballance wheel, or that which moves the *Pendulum* may go about in a minute, with an Index to shew seconds, that the great Wheel may go about in 12 hours, and that the wheel next it may go about in one hour to shew minutes : First, how many seconds there are in 12 hours, and that $12 \times 60 \times 60 = 43200$ these are the Beats that shall be in one turn of the Great Wheel. These are double, because there are two swings to one tooth of the Ballance wheel, the half of 43200 is 21600, now the Ballance wheel must needs be 30, divide 2160|0 by it the Quotient is 720 to be broke into three Quotients, whereof the first must needs be 12 for the teeth of the great wheel, divide 720 by it, the Quotient is 60 for the two Quotients remaining, which may be either 10 and 6, or 5 and 12, or 8 and $7\frac{1}{2}$, which last let-stand, then the work will stand thus, and the Pinions taken as you please to be all 8, the wheels must be 96. 64. 60. So then the great wheel will go about in twelve hours, the second wheel in an hour, and the Ballance wheel in a minute, as desired. I gave my Watch these Numbers to go above a year.

In my large Sphere going by Clock work, there is a motion for the Re-

8) 96. (11
8) 64. (8
8) 60. (7½

    30

10-140
 8..128
 8-120
72

volutio-

volution of the ☉ Apogeum writ down on the Circle to be made in 17096 years, but by Examining the Work, I find it to be 17100, that is but years more. For the Great Wheel fixed is 96, a spindle wheel of 12 bars turns round it 8 times in 24 hours, that is in 3 hours; after these, there are four whee's, 20. 73, 24, and 75, wrought by endless screws that are in value but one; therefore 3 x 20 x 73 x 24 x 75 $\overline{}$ 7884000 hours, which divided by 24 gives 328500o days equal 900 years : Now on the last wheel 75 is a Pinion of 6, turning a great Wheel that carries the Apogeum number 114, and 114 by 6 gives 19, and 900 x 19 $\overline{}$ 17100.

Rule 7. Of giving particular Motions to any Movement. The number of a Motion, is the Proportion that it bears to one turn of the hour wheel, or the Pinion of Report, from whithersoever it be taken, which proportion, being broken into two or three Quotients, will shew the Wheels and Pinions, as if you took it for the Beats of the Balance.

The last Note shall be concerning *Time* ; that which is ordinarily termed the *Hour of the Day* : Consider this in the length of days, which are two, distinguished only by the Revolution of the Earth : The first is the *Syderial* Day, where any fixt point or points of the Earth in the same Meridian or Azimuth returns from any Star to the same again ; the second the *Solar* Day, where the same Meridian of the Earth returns from the ☉ to the same again, neither of these days are the true Equinoctial day, indeed the *Syderial* is insensibly the same, if it be but for some small space of time , the difference being only some fourths and fifths of a degree flower in a day ; but the *Solar* is notably.

bly longer than the other, *viz.* by 3'. 56'. 53".
19'''. of time in a day , and from hence the
length of an hour is generally accounted :
Therefore to fit the *Pendulum* of a Watch or
Clock to this Solar day and hour : I. By the
Revolution of a fixed Star to the same point
again after one or more Revolutions (which
you must curiously observe by fixing your eye
to a point.) If the *Motion* for one Revolu-
tion want 3'. 56" of 24 hours , or for two
7'. 43" , for three , 40°. 39" , *&c.* then doth
your Watch go true to the Equal or Middle
Motion of the ☉, if otherwise , the *Pendulum*
must be altered to make it go so. II. By a Sun-
Dyal , which though it be made never so exact,
and your Motion so too , yet there will be a
considerable difference after some days , nay
even in one day, all which falls out by reason
of the inequality of Natural Days , (which at
last is settled and demonstrated by Mr. *William
Flamsted* , from whom (if God continue his
health) Astronomy hopes for a better Dress:
But this Manual will not admit the Table of
Equations, which you may find in Monsieur
Hugens's Horology, whereto you are referred.

Lastly, There is added a *Table of the Right As-
cension of the* ☉, and a *Table of the Right Ascen-
sion of the Stars* of the greater Magnitude, that
when any of them comes into the Meridian, by
substracting that of the ☉ from that of the Star
(adding 24 hours, if need be) leaves the hour of
the night.

And there is an *Excellent and useful Table*
the last of all, of 22 *Stars*, which here never rise
or set , and are constantly seen , which Table
shews their right Ascensions, and their time and
Azimuth when they come under the *Pole Star*,
therefore if you hang up a Thred and Plummet,
and looking through a small hole, (to take any

the Stars ray) obferve when any of thefe Stars come with the Pole *Star* to that Perpendicular; If you fubftract the ☉ Right Afcenfion, from the hour of the Stars coming under the North Pole, you have the true time of the Night to a minute. Many other ufes may be made of this Table, but there is not room here to fet them down.

The *Table of Right Afcenfions of the* ☉ is very exact to a fecond, to every degree of the Ecliptick; and becaufe the North-Signs have the fame Right Afcenfion with their Refpective degrees of the South-Signs 12 hours difference: The Table is contracted, and the common parts do anfwer two Columns: For finding the *Part Proportional* for the ☉ minutes, the differences are fet down to feconds, and may be fupplyed from the Table of Parts Proportional, if you enter the 10 differences under 6, as you did for the Log. under 10.

The Table of the Right Afcenfions and Declinations of one hundred of the Principal fixed Stars are rectified to the year 1680, and are taken from *Ricciolus* his laft Book, Entitled *Aftronomia Reformata*, are more exact than any other extant, and have their Differences fet by, for every ten years to rectifie them, and were thus done at the defire of that Worthy and Able *Phyfician*, and Incomparable *Mathematician*, Sir *Charles Scarborough*, for the benefit of the Induftrious Seaman.

The laft Table of the Stars about the North-Pole, are Calculated for the Latitude of *London*, and for the year 1680. Any Artift may compute them for other Latitudes, obferving that all fuch Stars whofe Right Afcenfions are above 9°. 14'. 10". and under 189°. 14'. 10". pafs the Meridian before they come under the Pole-Star, all the other Semicircle contrary. This Table will be
welcome

welcome to those that make Observations of the Stars, to know the true time of the night, and to rectifie their *Pendulum* Watches by: To all whom, let their Days and Nights be fortunate.

Soli Deo Gloria.

N	Log.	N	Log.	N	Log.
1	000000	34	531479	67	826075
2	301030	35	544068	68	832509
3	477121	36	556302	69	838849
4	602060	37	568202	70	845098
5	698970	38	579784	71	851258
6	778151	39	591065	72	857332
7	845098	40	602060	73	863323
8	903090	41	612784	74	869232
9	954242	42	623249	75	875061
10	000000	43	633468	76	880814
11	041393	44	643455	77	886491
12	079181	45	653212	78	892095
13	113943	46	662758	79	897627
14	146128	47	672098	80	903090
15	176091	48	681241	81	908485
16	204120	49	690196	82	913814
17	230449	50	698970	83	919078
18	255272	51	707570	84	924279
19	278754	52	716003	85	929419
20	301030	53	724276	86	934498
21	322219	54	732394	87	939519
22	342423	55	740363	88	944483
23	361728	56	748188	89	949390
24	380211	57	755875	90	954242
25	397940	58	763428	91	959041
26	414973	59	770852	92	963788
27	431364	60	778151	93	968483
28	447158	61	785330	94	973128
29	462398	62	792392	95	977724
30	477121	63	799341	96	982271
31	491362	64	805180	97	986772
32	505150	65	812913	98	991226
33	518514	66	819544	99	995635

B

N	0	1	2	3	4
100	000000	000434	000868	001301	001734
101	004321	004751	005181	005609	006038
102	008600	009026	009451	009876	010300
103	012837	013259	013679	014100	014520
104	017033	017451	017868	018284	018700
105	021189	021603	022016	022428	022841
106	025306	025715	026124	026533	026941
107	029384	029789	030195	030600	031004
108	033424	033826	034227	034628	035028
109	037426	037825	038223	038620	039017
110	041393	041787	042182	042575	042969
111	045323	045714	046105	046495	046885
112	049218	049605	049993	050380	050766
113	053078	053463	053846	054230	054613
114	056905	057286	057666	058046	058426
115	060698	061075	061452	061829	062206
116	064458	064832	065206	065580	065953
117	068186	068557	068928	069298	069668
118	071882	072250	072617	072985	073352
119	075547	075912	076276	076640	077004
120	079181	079543	079904	080266	080626
121	082785	083144	083503	083861	084219
122	086360	086716	087071	087426	087781
123	089905	090258	090611	090963	091315
124	093422	093772	094122	094471	094820
125	096910	097257	097604	097951	098297
126	100371	100715	101059	101403	101747
127	103804	104145	104487	104828	105169
128	107210	107549	107888	108227	108565
129	110590	110926	111262	111598	111934
130	113943	114277	114611	114944	115278
131	117271	117603	117934	118265	118595
132	120574	120903	121231	121560	121888
133	123852	124178	124504	124830	125155
134	127105	127429	127752	128076	128399

5	6	7	8	9	D
002166	002398	003029	003460	003891	432
006466	006894	007321	007748	008174	428
010724	011147	011570	011993	012415	424
014940	015360	015779	016197	016615	420
019116	019532	019947	020361	020775	416
023252	023664	024075	024486	024596	411
027250	027757	028164	028571	028978	408
031408	031812	032216	032619	033021	404
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043362	043755	044148	044540	044931	393
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062582	062958	063333	063708	064082	376
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073718	074085	074451	074816	075182	366
077368	077721	078094	078457	078819	364
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084576	084934	085291	085647	086004	357
088136	088490	088845	089198	089552	355
091667	092018	092369	092721	093071	352
095169	095518	095866	096215	096562	349
098644	098989	099335	099681	100026	347
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105519	105851	106191	106521	106870	341
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112270	112605	112940	113275	113609	336
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148	170262	170555	170848	171141	171434
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153	184691	184975	185259	185542	185825
154	187521	187803	188084	188366	188647
155	190332	190612	190892	191171	191451
156	193125	193403	193681	193959	194237
157	195900	196176	196453	196729	197005
158	198657	198932	199206	199481	199755
159	201397	201670	201943	202216	202488
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166	220108	220370	220631	220892	221153
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141450	141762	142076	142389	142702	314
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147676	147985	148294	148603	148911	309
150756	151063	151370	151676	151982	307
153815	154119	154424	154728	155032	305
156852	157154	157457	157759	158061	303
159868	160168	160469	160769	161068	301
162862	163161	163459	163758	164055	298
165838	166134	166430	166726	167022	297
168792	169086	169380	169674	169968	295
171726	172019	172311	172603	172895	292
174641	174932	175221	175512	175802	290
177516	177825	178113	178401	178689	289
180412	180699	180986	181272	181558	287
183270	183555	183839	184123	184407	285
186108	186391	186674	186956	187239	283
188918	189210	189496	189771	190051	281
191730	192009	192289	192567	192846	279
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197281	197556	197832	198107	198382	276
200029	200303	200577	200850	201124	274
202761	203033	203305	203577	203848	272
205475	205746	206016	206286	206556	271
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360783	360972	361161	361350	361539	189
362671	362859	363048	363236	363424	188
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366413	366610	366796	366983	367169	187
368287	368473	368659	368845	369030	186
370142	370328	370513	370698	370883	185
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432167	432328	432488	432649	432809	160
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280	447158	447313	447468	447623	447778
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932727	932778	932829	932879	932930	51
933234	933285	933335	933386	933437	51
933740	933791	933841	933892	933943	51
934246	934296	934347	934397	934448	51
934751	934801	934852	934902	934953	50
935255	935306	935356	935406	935457	50
935759	935809	935860	935910	935960	50
936162	936313	936363	936413	936463	50
936765	936815	936865	936916	936966	50
937267	937317	937367	937418	937468	50
937769	937819	937869	937919	937969	50
938269	938319	938370	938420	938469	50
938770	938820	938872	938920	938970	50
939270	939320	939370	939420	939470	50

N	0	1	2	3	4
870	939519	939569	939519	939668	939719
871	940018	940068	940188	940168	942218
872	940516	940566	940616	940666	940716
873	941014	941064	941114	941663	941213
874	941511	941561	941611	941660	941710
875	942008	942058	942107	942157	942206
876	942504	942554	942603	942653	942702
877	943000	943049	943099	943148	943198
878	943494	943544	943593	943643	943692
879	943989	944028	944088	944127	944186
880	944483	944532	944581	944631	944680
881	944976	945025	945074	945124	945173
882	945469	945518	945567	945616	945665
883	945961	946010	946059	946108	946157
884	946452	946501	946551	946600	946649
885	946943	946992	947041	947090	947119
886	947434	947483	947532	947581	947630
887	947924	947973	948022	948070	948119
888	948413	948462	948511	948560	948609
889	948902	948951	948999	949048	949097
890	949390	949439	949488	949536	949585
891	949878	949926	949975	950024	950073
892	950365	950414	950462	950511	950560
893	950851	950900	950949	950997	951046
894	951337	951386	951435	951483	951532
895	951823	951872	951920	951969	952017
896	952308	952356	952405	952453	952502
897	952792	952841	952889	952938	952986
898	953276	953325	953373	953421	953470
899	953760	953808	953856	953905	953953
900	954242	954291	954339	954387	954435
901	954725	954773	954821	954869	954918
902	955207	955255	955303	955351	955399
903	955688	955736	955784	955832	955880
904	956168	956216	956264	956313	956361

4	5	6	7	8	9	D
939719	939769	939818	939868	939918	939968	50
940217	940267	940317	940367	940417	940467	50
940715	940765	940815	940865	940915	940964	50
941213	941263	941313	941362	941412	941462	50
941710	941760	941809	941859	941909	941958	50
942206	942256	942305	942355	942405	942454	50
942702	942752	942801	942851	942900	942950	50
943198	943247	943297	943346	943396	943445	49
943692	943742	943791	943841	943890	943940	49
944186	944236	944285	944335	944384	944433	49
944680	944729	944779	944828	944877	944927	49
945173	945222	945272	945321	945370	945419	49
945666	945715	945764	945813	945862	945911	49
946158	946207	946256	946305	946354	946403	49
946649	946698	946747	946796	946845	946894	49
947140	947189	947237	947287	947336	947385	49
947630	947679	947728	947777	947826	947875	49
948119	948168	948217	948266	948315	948364	49
948608	948657	948706	948755	948804	948853	49
949097	949146	949195	949245	949292	949341	49
949585	949634	949683	949731	949780	949829	49
950072	950121	950170	950219	950267	950316	49
950559	950608	950657	950706	950754	950803	49
951046	951095	951143	951192	951240	951289	49
951533	951582	951631	951677	951726	951775	49
952017	952066	952114	952163	952211	952259	49
952502	952550	952599	952647	952696	952744	48
952986	953034	953083	953131	953180	953228	48
953470	953518	953566	953615	953663	953711	48
953953	954001	954049	954098	954146	954194	48
954436	954484	954532	954580	954628	954977	48
954918	954967	955015	955062	955110	955158	48
955400	955447	955495	955543	955591	955640	48
955881	955928	955976	956024	956072	956120	48
956361	956409	956457	956505	956553	956601	48

N	0	1	2	3	4
905	956649	956697	956745	956793	956840
906	957128	957176	957224	957272	957320
907	957607	957655	957703	957751	957799
908	958086	958134	958181	958229	958277
909	958564	958612	958659	958707	958755
910	959041	959089	959137	959184	959232
911	959518	959566	959614	959661	959709
912	959995	960042	960090	960138	960185
913	960471	960518	960566	960613	960661
914	960946	960994	961041	961089	961136
915	961421	961468	961516	961563	961611
916	961895	961943	961990	962038	962085
917	962369	962417	962464	962511	962559
918	962843	962890	962937	962985	963032
919	963315	963363	963410	963457	963504
920	963788	963835	963882	963929	963977
921	964260	064307	964354	964401	964448
922	964731	964778	964825	964872	964919
923	965202	965246	965296	965343	965390
924	965672	965719	965766	965813	965860
925	966142	966189	966236	966283	966329
926	966611	966658	966705	966752	966798
927	967080	967127	967173	967220	967267
928	967548	967595	967642	967688	967735
929	968016	968062	968109	968156	968202
930	968481	968530	968576	968623	968670
931	968950	968996	969043	969090	969136
932	969416	969463	969509	969555	969602
933	969882	969928	969975	970021	970068
934	970247	970393	970440	970486	970533
935	970812	970858	970904	970951	970997
936	971276	971322	971369	971415	971461
937	971740	971786	971832	971879	971925
938	972203	972249	972295	972342	972388
939	972666	972712	972758	972804	972851

5	6	7	8	9	D
956888	956936	956984	957032	957080	48
957368	957416	957464	957512	957559	48
957847	957894	957942	957990	958038	48
958325	958373	958421	958468	958516	48
958803	958850	958898	958946	958994	48
959280	959328	959375	959423	959471	48
959757	959804	959852	959900	959947	48
960233	960280	960328	960376	960423	48
960709	960756	960804	960851	960899	48
961184	961231	961279	961326	961374	47
961658	961706	961753	961801	961848	47
962132	962180	962227	962275	962322	47
962606	962653	962701	962748	962795	47
963079	963126	963174	963221	963268	47
963552	963599	963646	963693	963741	47
964024	964071	964118	964165	964212	47
964495	964542	964590	964637	964684	47
964966	965013	965061	965108	965155	47
965437	965484	965531	965578	965624	47
965907	965954	966001	966048	966095	47
966376	966423	966470	966517	966564	47
966845	966892	966939	966986	967033	47
967314	967361	967408	967454	967501	47
967782	967829	967875	967922	967969	47
968249	968296	968343	968389	968436	47
968716	968763	968810	968856	968903	47
969183	969229	969276	969323	969369	47
969649	969695	969742	969789	969835	47
970114	970161	970207	970254	970300	47
970579	970626	970672	970719	970765	46
971044	971090	971137	971183	971229	46
971508	971554	971601	971647	971693	46
971971	972018	972064	972110	972157	46
972434	972481	972527	972573	972619	45
972897	972943	972989	973035	973082	46

D

N	0	1	2	3	4
940	973118	973174	973220	973266	973313
941	973590	973636	973082	973728	974189
942	974051	974097	974143	974604	974650
943	974512	9 4558	974604	975110	974650
944	974972	975018	975064	975110	975116
945	975432	975478	975524	975570	975616
946	975891	975937	975983	976029	976075
947	976250	975937	976442	976488	976533
948	976828	976854	976899	976946	976992
949	977266	977212	977358	977403	977449
950	977714	977769	977815	977861	977906
951	978181	978226	978272	978317	978363
952	978637	978683	978728	978774	978819
953	979063	979138	979184	979230	979275
954	979548	979594	979639	979685	979731
955	980003	980049	980094	980140	980185
956	980458	980503	980539	980594	980640
957	980912	980957	981003	981048	981093
958	981366	981411	981456	981501	981547
959	981819	981864	981909	981954	982000
960	982271	982316	982362	982407	982452
961	982723	982769	982814	982859	982904
962	983175	983220	983265	983310	983356
963	983626	983671	983716	983762	983807
964	984077	984122	984167	984212	984257
965	984527	984572	984617	984662	984707
966	984977	985022	985067	985112	985157
967	985426	985471	985516	985561	985606
968	985875	985920	985965	986010	986055
969	986324	986369	986413	986458	986503
970	986771	986816	986861	986906	986951
971	987219	987264	987309	987353	987398
972	987666	987711	987756	987300	987845
973	988113	988157	988202	988247	988291
974	988559	988604	988648	988693	988737

4	5	6	7	8	9	D
973313	973359	973405	973451	973497	973543	46
973774	973820	973866	973913	973959	974005	45
974235	974281	974327	974374	974420	974466	46
974696	974742	974788	974834	974880	974926	46
975156	975202	975248	975294	975340	975386	46
975616	975662	975707	975753	975799	975845	46
976075	976121	976167	976212	976258	976304	46
976533	976579	976625	976671	976717	976763	46
976991	977037	977083	977129	977175	977220	46
977449	977495	977541	977586	977632	977678	46
977906	977952	977998	978043	978089	978135	46
978363	978409	978454	978500	978546	978591	46
978819	978865	978911	978956	979002	979047	46
979275	979321	979366	979412	979457	979503	46
979730	979776	979821	979867	979912	979958	46
980186	980231	980276	980322	980367	980412	45
980640	980685	980730	980776	980821	980867	45
981094	981139	981184	981229	981275	981320	45
981547	981592	981637	981683	981728	981773	45
982000	982045	982090	982135	982181	982226	45
982452	982497	982543	982588	982633	982678	45
982904	982949	982994	983040	983085	983130	45
983356	983401	983446	983491	983526	983581	45
983807	983852	983897	983942	983987	984032	45
984257	984302	984347	984392	984437	984482	45
984707	984752	984797	984842	984887	984932	45
985157	985202	985247	985292	985337	985382	45
985606	985651	985696	985741	985786	985830	45
986055	986100	986144	986189	986234	986279	45
986503	986548	986593	986637	986682	986727	45
986951	986996	987040	987085	987130	987175	45
987398	987443	987488	987532	987577	987622	45
987845	987890	987934	987979	988024	988068	45
988291	988336	988381	988425	988470	988514	45
988737	988781	988826	988871	988916	988960	45

N	0	1	2	3	4
975	989005	989049	989094	989138	989183
576	989450	989494	989539	989583	989616
977	989895	989939	989983	990028	990072
578	990339	990383	990428	990472	990516
979	990783	990827	990871	990916	990960
980	991226	991170	991315	991359	991403
981	991669	991713	991757	991802	991846
982	992111	992156	992200	992244	992288
983	992554	992598	992642	992686	992730
984	992995	993039	993083	993127	993171
985	993436	993480	993524	993568	993612
986	993877	993921	993965	994009	994052
987	994317	994361	994405	994449	994493
988	994757	994801	994845	994889	994933
989	995196	995240	995284	995328	995372
990	995635	995679	995723	995767	995811
991	996074	996117	996161	996205	996249
992	996512	996555	996599	996643	996687
993	996949	996993	997037	997080	997124
994	997386	997430	997474	997517	997561
995	997823	997867	997910	997954	997998
996	998259	998303	998346	998390	998434
997	998695	998738	998782	998826	998869
998	999130	999174	999218	999261	999305
999	999565	999609	999652	999696	999739

End of the Table

5	6	7	8	9	D
989227	989272	989316	989361	989405	45
989672	989717	989761	989806	989850	44
990117	990161	990206	990250	990294	44
990561	990605	990650	990694	990738	44
991294	9915 9	991093	991137	991182	44
991448	991492	991536	991580	991625	44
991892	991934	991979	992023	992067	44
992333	992377	992421	992165	992509	44
992774	992819	992863	992907	992951	44
993216	993260	993304	993348	993392	44
993657	993701	993745	993789	993833	44
994097	994141	994185	994229	994273	44
994537	994581	994625	994669	994713	44
994977	995021	995065	995109	995152	44
995416	995460	995504	995547	995591	44
995854	995898	995942	995986	996030	44
996293	996327	996380	996424	996468	44
996731	996774	996818	996862	996906	44
997168	997212	997255	997299	997 43	44
997695	997648	997692	997736	997779	44
998041	998085	998129	998172	998216	44
998477	998521	998564	998608	998652	44
998913	998956	999000	999043	999087	44
999438	999292	999435	999479	999522	44
999783	999826	999870	999913	999956	43

Of Logarithms.

Here followeth

A TABLE

OF

PARTS PROPORTIONAL,

FOR

The finding the Logarithms of all Numbers betwixt 10000 and 100000.

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
43	4	8	12	17	21	25	30	34	38
44	4	8	13	17	22	26	30	35	39
45	4	9	13	18	22	27	31	36	40
46	4	9	13	18	23	27	32	36	41
47	4	9	14	18	23	28	32	37	42
48	4	9	14	19	24	28	33	38	43
49	4	9	14	19	24	29	34	39	44
50	5	10	15	20	25	30	35	40	45
51	5	10	15	20	25	30	35	40	45
52	5	10	15	20	26	31	36	41	46
53	5	10	15	21	26	31	37	42	47
54	5	10	16	21	27	32	37	43	48
55	5	11	16	22	27	33	38	44	49
56	5	11	16	22	28	33	39	44	50
57	5	11	17	22	28	34	39	45	51
58	5	11	17	23	29	34	40	45	52
59	5	11	17	23	29	35	41	47	53
60	6	12	18	24	30	36	42	48	54
61	6	12	18	24	30	36	42	48	54
62	6	12	18	24	31	27	43	49	55
63	6	12	19	25	31	37	44	50	56
64	6	12	19	25	32	38	44	51	57
65	6	13	19	26	32	39	45	52	58
66	6	13	19	26	33	39	46	52	59
67	6	13	20	26	33	40	46	53	60
68	6	13	20	27	34	40	47	54	61
69	6	13	20	27	34	41	48	55	62
70	7	14	21	28	35	42	49	56	63
71	7	14	21	28	35	42	49	56	63
72	7	14	21	28	36	43	50	57	64
73	7	14	21	29	36	43	51	58	65
74	7	14	22	29	37	44	51	59	66
75	7	15	22	30	37	45	52	60	67
76	7	15	22	30	38	45	53	60	68

D	1	2	3	4	5	6	7	8	9
77	7	15	23	30	38	46	53	61	69
78	7	15	23	31	39	46	54	62	70
79	7	15	23	31	39	47	55	63	71
80	8	15	24	32	40	48	56	64	72
81	8	16	24	32	40	48	56	64	72
82	8	16	24	32	41	49	57	65	73
83	8	16	24	33	41	49	58	65	74
84	8	16	25	33	42	50	58	67	75
85	8	17	25	34	42	51	59	68	76
86	8	17	25	34	43	51	60	68	77
87	8	17	26	34	43	52	60	69	78
88	8	17	26	35	44	52	61	70	79
89	8	17	26	35	44	53	62	71	80
90	9	18	27	36	45	54	63	71	81
91	9	18	27	36	45	54	63	72	81
92	9	18	27	36	46	55	64	73	82
93	9	18	27	37	46	55	64	74	83
94	9	18	28	37	47	56	65	75	84
95	9	19	28	38	47	57	66	76	85
96	9	19	28	38	48	57	67	76	86
97	9	19	29	38	48	58	67	77	87
98	9	19	29	39	49	58	68	78	88
99	9	19	29	39	49	59	69	79	89
100	10	20	30	40	50	60	70	80	90
101	10	20	30	40	50	60	70	80	91
102	10	20	30	41	51	61	71	81	91
103	10	20	30	41	51	61	72	82	92
104	10	20	31	41	52	62	72	83	93
105	10	21	31	42	52	63	73	84	94
106	10	21	31	42	53	63	74	84	95
107	10	21	32	42	53	64	74	85	96
108	10	21	32	43	54	64	75	86	97
109	10	21	32	43	54	65	76	87	98
110	11	22	33	44	55	66	77	88	99

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
111	11	22	33	44	55	66	77	88	99
112	11	22	33	44	56	67	78	89	100
113	11	22	33	45	57	67	78	90	101
114	11	22	34	45	57	68	79	91	102
115	11	23	34	46	57	69	80	92	103
116	11	23	34	46	58	69	81	92	104
117	11	23	35	46	58	70	81	93	105
118	11	23	35	47	59	70	82	94	106
119	11	23	35	47	59	71	83	95	107
120	12	24	36	48	60	72	84	95	108
121	12	24	36	48	60	72	84	96	108
122	12	24	36	48	61	73	85	97	109
123	12	24	36	48	61	73	86	98	110
124	12	24	37	49	62	74	86	99	111
125	12	25	37	50	62	75	87	100	112
126	12	25	37	50	63	75	88	100	113
127	12	25	38	50	63	76	88	101	114
128	12	25	38	51	64	76	89	102	115
129	12	25	38	51	64	77	90	103	116
130	13	26	39	52	65	78	91	104	117
131	13	26	39	52	65	78	91	104	117
132	13	26	39	52	66	79	92	105	118
133	13	26	39	53	66	79	93	106	119
134	13	26	40	53	67	80	93	107	120
135	13	27	40	54	67	81	94	108	121
136	13	27	40	54	68	81	95	108	122
137	13	27	41	54	68	82	95	109	123
138	13	27	41	55	69	82	96	110	124
139	13	27	41	55	69	83	97	111	125
140	14	28	42	56	70	84	98	112	126
141	14	28	42	56	70	84	98	112	126
142	14	28	42	56	71	85	99	113	127
143	14	28	42	57	71	85	100	114	128
144	14	28	43	57	72	86	100	115	129

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
145	14	28	43	58	72	87	101	116	130
146	14	29	43	58	73	87	102	116	131
147	14	29	44	58	73	88	102	117	131
148	14	29	44	59	74	88	103	118	133
149	14	29	44	59	74	89	104	119	134
150	15	30	45	60	75	90	105	120	135
151	15	30	45	60	75	90	105	120	135
152	15	30	45	60	76	91	106	121	136
153	15	30	45	60	76	91	107	122	137
154	15	30	46	61	77	92	107	123	138
155	15	31	46	62	77	93	108	124	138
156	15	31	46	62	78	93	109	124	140
157	15	31	47	62	78	94	109	125	141
158	15	31	47	63	79	94	110	126	142
159	15	31	47	63	79	95	111	127	143
160	16	32	48	64	80	96	112	128	144
161	16	32	48	64	80	96	112	128	144
162	16	32	48	64	81	57	113	129	145
163	16	32	48	65	81	98	114	130	146
164	16	32	49	66	82	98	114	131	147
165	16	33	49	66	82	99	115	132	148
166	16	33	49	66	83	99	116	132	149
167	16	33	50	66	83	100	116	133	150
168	16	33	50	67	84	100	117	134	151
169	16	33	50	67	84	101	118	135	152
170	17	34	51	68	85	102	119	136	153
171	17	34	51	68	85	102	119	136	153
172	17	34	51	68	86	103	120	137	154
173	17	34	51	69	86	103	121	138	155
174	17	34	52	69	87	104	121	139	156
175	17	34	52	70	87	105	122	140	157
176	17	35	52	70	88	105	123	140	158
177	17	35	53	70	88	106	123	141	159
178	17	35	53	71	89	106	124	142	160

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
179	17	35	53	71	89	107	125	143	161
180	18	36	54	72	90	108	126	144	162
181	18	36	54	72	90	108	126	144	162
182	18	36	54	72	91	109	127	145	163
183	18	36	54	73	91	109	128	146	164
184	18	36	55	73	92	110	128	147	165
185	18	37	55	74	92	111	129	148	166
186	18	37	55	74	93	111	130	148	167
187	18	37	56	74	93	112	130	149	168
188	18	37	56	75	94	112	131	150	169
189	18	37	56	75	94	113	132	151	170
190	19	38	57	76	95	114	133	152	171
191	19	38	57	76	95	114	133	153	171
192	19	38	57	76	96	115	134	153	172
193	19	38	57	77	96	115	135	154	174
194	19	38	58	77	97	116	135	155	174
195	19	39	58	78	97	117	136	156	175
196	19	39	59	78	98	117	136	156	176
197	19	39	59	78	98	118	137	157	177
198	19	39	59	79	99	118	138	158	178
199	19	9	60	79	99	119	139	159	179
200	20	40	60	80	100	120	140	160	180
201	20	40	60	80	100	120	140	160	180
202	20	40	60	80	101	121	141	161	181
203	20	40	60	81	101	121	142	162	182
204	20	40	61	81	102	122	142	163	183
205	20	41	61	82	102	123	143	164	184
206	20	41	61	82	103	123	144	164	185
207	20	41	62	82	103	124	144	165	186
208	20	41	62	83	104	124	145	166	187
209	20	41	62	83	104	125	146	167	188
210	21	42	63	84	105	126	147	168	189
211	21	42	63	84	105	126	147	168	189
212	21	42	63	84	106	127	148	169	190

D	1	2	3	4	5	6	7	8	9
213	21	42	63	85	106	117	149	170	191
214	21	42	64	85	107	128	149	171	192
215	21	43	64	86	107	129	150	172	193
216	21	43	64	86	108	129	151	172	194
217	21	43	65	86	108	130	151	173	195
218	21	43	65	87	109	130	152	174	196
219	21	43	65	87	109	131	153	175	197
220	22	44	66	88	110	132	154	176	198
221	22	44	66	88	110	132	154	176	198
222	22	44	66	88	111	133	155	177	199
223	22	44	66	89	111	133	156	178	200
224	22	44	67	89	112	134	156	179	201
225	22	45	67	90	112	135	157	180	202
226	22	45	67	90	113	135	158	180	203
227	22	45	68	90	113	136	158	181	204
228	22	45	68	91	113	136	159	182	205
229	22	45	68	91	114	137	160	183	206
230	23	46	69	92	115	138	161	184	207
231	23	46	69	92	115	138	161	184	207
232	23	46	69	92	116	139	162	185	208
233	23	46	69	93	116	139	163	186	209
234	23	46	70	93	117	140	163	187	210
235	23	47	70	94	117	141	164	188	211
236	23	47	70	94	118	141	165	188	212
237	23	47	71	94	118	142	165	189	213
238	23	47	71	95	119	142	166	190	214
239	23	47	71	95	119	143	167	191	215
240	24	48	72	96	120	144	168	192	216
241	24	48	72	96	120	144	168	193	216
242	24	48	72	96	121	145	169	193	217
243	24	48	72	97	121	145	170	194	218
244	24	48	73	97	122	146	170	195	219
245	24	49	73	98	112	147	171	196	220
246	24	49	73	98	123	147	172	196	221

D	1	2	3	4	5	6	7	8	9
247	24	49	74	98	123	148	172	197	221
248	24	49	74	99	124	148	173	198	223
249	24	49	74	99	124	149	174	199	224
250	25	50	75	100	125	150	175	200	225
251	25	50	75	100	125	150	175	200	225
252	25	50	75	100	126	151	176	201	226
253	25	50	75	101	126	151	177	202	227
254	25	50	76	101	127	152	177	203	228
255	25	51	76	102	127	153	178	204	229
256	25	51	76	102	128	153	179	204	230
257	25	51	77	102	128	154	179	205	231
258	25	51	77	103	129	154	180	206	232
259	25	51	77	103	129	155	181	207	233
260	26	52	78	104	130	156	182	208	234
261	26	52	78	104	130	156	182	208	234
262	26	52	78	104	131	157	183	209	235
263	26	52	78	105	131	157	184	210	236
264	26	52	79	105	132	158	184	211	237
265	26	53	79	106	132	159	185	212	238
266	26	53	79	106	133	159	186	212	239
267	26	53	80	106	133	160	186	213	240
268	26	53	80	107	134	160	187	214	241
269	26	53	80	107	134	161	188	215	242
270	27	54	81	108	135	162	189	216	243
271	27	54	81	108	135	162	189	216	243
272	27	54	81	108	136	163	190	217	244
273	27	54	81	109	136	163	191	218	245
274	27	54	82	109	137	164	191	219	246
275	27	55	82	110	1.7	165	192	220	247
276	27	55	82	110	138	165	193	220	248
277	27	55	83	110	138	166	193	221	249
278	27	55	83	111	139	166	194	222	250
279	27	55	83	111	139	167	195	223	251
280	28	56	84	112	140	168	196	224	252

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
281	28	56	84	112	140	168	196	224	252
282	28	56	84	112	141	169	197	225	253
283	28	56	84	113	141	169	198	226	254
284	28	56	85	113	142	170	198	227	255
285	28	57	85	114	142	171	199	228	256
286	28	57	85	114	143	171	200	228	257
287	28	57	86	114	143	172	200	229	258
288	28	57	86	115	144	172	201	230	259
289	28	57	86	115	144	173	202	231	260
290	29	58	87	116	145	174	203	232	261
291	29	58	87	116	145	174	203	232	261
292	29	58	87	116	146	175	204	233	262
293	29	58	88	117	146	175	205	234	263
294	29	58	88	117	147	176	205	235	264
295	29	59	88	118	147	177	206	235	265
296	29	59	88	118	148	177	207	236	266
297	29	59	89	118	148	178	207	237	267
298	29	59	89	119	149	178	208	238	268
299	29	59	89	119	149	179	209	239	269
300	30	60	90	120	150	180	210	240	270
301	30	60	90	120	150	180	210	240	270
302	30	60	90	120	151	181	211	241	271
303	30	60	90	121	151	181	212	242	272
304	30	60	91	121	152	182	213	243	273
305	30	61	91	122	152	183	213	244	274
306	30	61	91	122	153	183	214	244	275
307	30	61	92	122	153	184	214	245	276
308	30	61	92	123	154	184	215	246	277
309	30	61	92	123	154	185	216	247	278
310	31	62	93	124	155	186	217	248	279
311	31	62	93	124	155	186	217	248	279
312	31	62	93	124	156	187	218	249	280
313	31	62	93	125	156	187	219	250	281
314	31	62	94	125	157	188	219	251	282

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
315	31	63	94	126	157	189	220	252	283
316	31	63	94	126	158	189	221	252	284
317	31	63	95	126	158	190	221	253	285
318	31	63	95	127	159	190	222	254	286
319	31	63	95	127	159	191	223	255	287
320	32	64	96	128	160	192	224	256	288
321	32	64	96	128	160	192	224	256	288
322	32	64	96	128	161	193	225	257	289
323	32	64	96	129	161	193	226	258	290
324	32	64	97	129	162	194	226	259	291
325	32	65	97	130	162	195	227	260	292
326	32	65	97	130	163	195	228	260	293
327	32	65	98	130	163	196	228	261	294
328	32	65	98	131	163	196	229	262	295
329	32	65	98	131	164	197	230	263	296
330	33	66	99	132	165	198	231	264	297
331	33	66	99	132	165	198	231	264	297
332	33	66	99	132	166	199	232	265	298
333	33	66	99	133	166	199	233	266	299
334	33	66	100	133	167	200	233	267	300
335	33	67	100	134	167	201	234	268	301
336	33	67	100	134	168	201	235	268	302
337	33	67	101	134	168	202	235	269	303
338	33	67	101	135	169	202	236	270	304
339	33	67	101	135	169	203	237	271	305
340	34	68	102	136	170	204	238	272	306
341	34	68	102	136	170	204	238	272	306
342	34	68	102	136	171	205	239	273	307
343	34	68	102	137	171	205	240	274	308
344	34	68	103	137	172	206	240	275	309
345	34	69	103	138	172	207	241	276	310
346	34	69	103	138	173	207	242	276	311
347	34	69	104	138	173	208	242	277	312
348	34	69	104	139	174	208	243	278	313

D	1	2	3	4	5	6	7	8	9
349	34	69	104	139	174	209	244	279	314
350	34	70	105	140	175	210	245	280	315
351	35	70	105	140	175	210	245	280	315
352	35	70	105	140	176	211	246	281	316
353	35	70	105	141	177	212	247	282	317
354	35	70	106	141	177	212	247	283	318
355	35	71	106	142	177	213	248	284	319
356	35	71	106	442	178	213	249	284	320
357	35	71	107	143	178	214	249	285	321
358	35	71	107	143	179	214	250	286	322
359	35	71	107	143	179	215	251	287	323
360	36	72	108	144	180	216	251	288	324
361	36	72	108	144	180	216	252	288	325
362	36	72	108	144	181	217	252	289	325
363	36	72	108	145	181	217	253	290	326
364	36	72	109	145	182	218	254	291	327
365	36	73	109	146	182	219	254	292	328
366	36	73	109	146	182	219	255	292	329
367	36	73	110	146	183	220	256	293	330
368	36	73	110	147	184	220	256	294	331
369	36	73	110	147	184	221	257	295	332
370	37	74	111	148	185	222	258	296	333
371	37	74	111	148	185	222	259	296	333
372	37	74	111	148	186	223	260	297	334
373	47	74	111	149	186	223	261	298	335
374	37	74	112	149	187	224	261	299	336
375	37	75	112	150	187	225	262	300	337
376	37	75	112	150	188	225	262	300	338
377	37	75	113	150	188	226	263	301	339
378	37	75	113	151	189	226	264	302	340
379	37	75	113	151	189	227	265	303	341
380	37	76	114	152	190	228	266	304	342
381	38	76	114	152	190	228	266	304	342
382	38	76	114	152	191	2 9	267	305	343

D	1	2	3	4	5	6	7	8	9
383	38	76	114	153	191	229	268	306	344
384	38	76	115	153	192	230	268	307	345
385	38	77	115	154	192	231	269	308	346
386	38	77	115	154	193	231	270	308	347
387	38	77	116	154	193	232	270	309	348
388	38	77	116	155	194	232	271	310	349
389	38	78	116	155	174	233	272	311	350
390	39	78	117	156	195	233	273	312	351
391	39	78	117	156	195	233	273	312	351
392	9	78	117	156	196	234	274	313	352
393	39	78	117	157	196	235	275	314	353
394	39	78	118	157	197	236	275	315	354
395	39	79	118	158	197	237	276	316	355
396	39	79	118	158	198	237	277	316	356
397	39	79	119	158	198	238	277	317	357
398	39	79	119	159	199	238	278	318	358
399	39	79	19	159	199	239	279	319	359
400	40	80	120	160	200	240	280	320	360
401	40	80	120	160	200	210	280	320	360
402	40	80	120	160	201	241	281	321	361
403	40	80	120	161	201	241	282	322	362
404	40	80	121	161	202	242	282	323	363
405	40	81	121	162	202	243	283	324	364
406	40	81	121	162	203	243	284	324	365
407	40	81	122	162	203	244	284	325	366
408	40	81	122	163	204	244	285	326	367
409	40	81	122	163	204	245	286	327	368
410	41	82	123	164	205	246	287	328	369
411	41	82	123	164	205	246	287	328	369
412	41	82	123	164	206	247	288	329	370
413	41	82	123	165	206	247	289	330	371
414	41	82	124	165	207	248	289	331	372
415	41	82	124	166	207	249	290	332	373
416	41	83	124	166	208	249	291	332	374

Parts Proportional.

D	1	2	3	4	5	6	7	8	9
417	41	83	125	166	208	250	291	333	375
418	41	83	125	167	209	250	292	334	376
419	41	83	125	167	209	251	293	335	377
420	42	84	126	168	210	252	294	336	378
421	42	84	126	168	210	252	294	336	378
422	42	84	126	168	211	253	295	337	379
423	42	84	126	169	211	253	295	338	380
424	42	84	127	169	212	254	296	339	381
425	42	85	127	170	212	255	297	340	382
426	42	85	127	170	213	255	298	340	383
427	42	85	128	170	213	256	298	341	384
428	42	85	128	171	214	256	299	342	385
429	42	85	128	171	214	257	300	343	386
430	43	86	129	172	215	258	301	344	387
431	43	86	129	172	215	258	301	344	387
432	43	86	129	172	216	259	302	345	388
433	43	86	129	173	216	259	303	346	389
434	43	86	130	173	217	260	304	347	390
435	43	87	130	174	217	261	304	348	391

A

A
TABLE
OF
Artificial Sines
AND
TANGENTS,
For every
Degree and Minute
OF THE
QUADRANT,
Fitted to the Size
OF THE
LOGARITHMS.

M	Sine	Co-sine	Tangent	Co-tang.	
0	0.000000	10.000000	0.000000	Infinita.	60
1	6.463716	9.999999	6.463716	13.536274	59
2	6.764756	9.999999	6.764756	13.235244	58
3	6.940847	9.999999	6.940847	13.059153	57
4	7.065786	9.999999	7.065786	12.934214	56
5	7.162696	9.999999	7.163656	12.837304	55
6	7.241877	9.999999	7.241878	12.758122	54
7	7.308824	9.999999	7.308825	12.691175	53
8	7.366816	9.999999	7.366817	12.633183	52
9	7.417968	9.999999	7.417970	12.582030	51
10	7.462726	9.999998	7.463727	12.536273	50
11	7.505118	9.999998	7.505120	12.494882	49
12	7.542506	9.999997	7.542909	12.457091	48
13	7.577668	9.999997	7.577272	12.422328	47
14	7.609853	9.999996	7.609857	12.390145	46
15	7.639816	9.999996	7.639826	12.360180	45
16	7.667844	9.999995	7.667849	12.332151	44
17	7.694173	9.999995	7.694179	12.305821	43
18	7.718977	9.999994	7.719003	12.281997	42
19	7.742477	9.999993	7.742484	12.257516	41
20	7.764754	9.999993	7.764761	12.235239	40
21	7.785943	9.999992	7.785951	12.214049	39
22	7.806146	9.999991	7.806155	12.193845	38
23	7.825451	9.999990	7.825460	12.174540	37
24	7.842934	9.999989	7.843944	12.156056	36
25	7.861662	9.999989	7.861674	12.138326	35
26	7.878695	9.999988	7.878708	12.121292	34
27	7.895085	9.999987	7.895099	12.104901	33
28	7.910879	9.999986	7.910894	12.089106	32
29	7.926219	9.999985	7.926134	12.073866	31
30	7.940842	9.899983	7.940858	12.059142	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	7.940842	9.999983	7.940858	12.059142	30
31	7.955082	9.999982	7.955100	12.044900	29
32	7.988870	9.999981	7.968889	12.031111	28
33	7.982233	9.999980	7.982253	12.017747	27
34	7.995198	9.999978	7.995215	12.004781	26
35	8.007787	9.999977	7.007810	11.992191	25
36	8.020021	9.999976	8.020044	11.979956	24
37	8.031919	9.999975	8.031945	11.968055	23
38	8.043501	9.999973	8.043527	11.956473	22
39	8.054781	9.999972	8.054809	11.945181	21
40	8.065776	9.999971	8.065806	11.934194	20
41	8.076500	9.999969	8.076531	11.923469	19
42	8.086965	9.999968	8.086997	11.913002	18
43	8.097183	9.999966	8.097217	11.902783	17
44	8.107167	9.999964	8.107203	11.892797	16
45	8.116926	9.999963	8.116963	11.883037	15
46	8.126471	9.999961	8.126510	11.873490	14
47	8.135810	9.999959	8.135851	11.864149	13
48	8.144953	9.999958	8.144996	11.855004	12
49	8.153907	9.999956	8.153952	11.846048	11
50	8.162681	9.999954	8.162737	11.837273	10
51	8.171280	9.999952	8.171328	11.828672	9
52	8.179713	9.999951	8.179763	11.820237	8
53	8.187985	9.999948	8.188036	11.811964	7
54	8.196102	9.999946	8.196156	11.803844	6
55	8.204070	9.999944	8.204126	11.795874	5
56	8.211895	9.999941	8.211953	11.788047	4
57	8.219581	9.999940	8.219641	11.780359	3
58	8.227134	9.999938	8.227195	11.772805	2
59	8.234557	9.999936	8.234621	11.765379	1
60	8.241855	9.996934	8.241921	11.758079	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 1.

M	Sine	Co-fine	Tangent	Co-Tang.	
0	8.241855	9.999934	8.241921	11.758079	60
1	8.249033	9.999932	8.249102	11.750898	59
2	8.256094	9.999929	8.256165	11.743835	58
3	8.163042	9.999927	8.263115	11.736885	57
4	8.269881	9.999925	8.269956	11.730044	56
5	8.276614	9.999922	8.276691	11.723309	55
6	8.283243	9.999920	8.283323	11.716677	54
7	8.289773	9.999918	8.289856	11.716144	53
8	8.296207	9.999915	8.296292	11.703708	52
9	8.302546	9.999913	8.302624	11.697366	51
10	8.308794	9.999910	8.308884	11.691116	50
11	8.314954	9.999907	8.315046	11.684954	49
12	8.321027	9.999905	8.321122	11.678878	48
13	8.327016	9.999902	8.327114	11.672886	47
14	8.332924	9.998899	8.333025	11.666975	46
15	8.338753	9.999897	8.338856	11.661144	45
16	8.344504	9.999894	8.344610	11.655390	44
17	8.350180	9.999891	8.350289	11.649711	43
18	8.355783	9.999888	8.355895	11.644105	42
19	8.361315	9.999885	8.361430	11.638570	41
20	8.366777	9.999882	8.366895	11.633105	40
21	8.372171	9.999879	8.372292	11.627708	39
22	8.377499	9.999876	8.377622	11.622378	38
23	8.382762	9.999873	8.382889	11.617111	37
24	8.387962	9.999870	8.388092	11.611908	36
25	8.393101	9.999867	8.393234	11.606766	35
26	8.398179	9.999864	8.398315	11.601685	34
27	8.403199	9.999861	8.403338	11.596662	33
28	8.408161	9.999858	8.408304	11.591696	32
29	8.413068	9.999854	8.413213	11.586787	31
30	8.417919	9.999851	8.418068	11.581932	30
	Co-fine	Sine	Co-tang.	Tangent	M

Degree 1.

M	Sine	Co-sine	Tangent	Co-tang.	
30	8.417919	9.999851	8.418068	11.581932	30
31	8.422717	9.999848	8.422869	11.577131	29
32	8.427462	9.999844	8.427618	11.572382	28
33	8.432156	9.999841	8.432315	11.567685	27
34	8.436800	9.999838	8.436962	11.563038	26
35	8.441394	9.999834	8.441560	11.558440	25
36	8.445941	9.999831	8.446110	11.553990	24
37	8.450440	9.999827	8.450613	11.549387	23
38	8.454893	9.999824	8.455070	11.544930	22
39	8.459301	9.999820	8.459481	11.540519	21
40	8.463665	9.999816	8.463849	11.536151	20
41	8.467985	9.999812	8.468172	11.531828	19
42	8.472263	9.999809	8.472454	11.527546	18
43	8.476498	9.999805	8.476693	11.523307	17
44	8.480692	9.999801	8.480892	11.519108	16
45	8.484848	9.999797	8.485050	11.514950	15
46	8.488963	9.999794	8.489170	11.510830	14
47	8.493040	9.999790	8.493250	11.506750	13
48	8.497078	9.999786	8.497292	11.502707	12
49	8.501080	9.999782	8.501298	11.498702	11
50	8.505045	9.999778	8.505267	11.494733	10
51	8.508974	9.999774	8.509200	11.490800	9
52	8.512867	9.999769	8.513098	11.486902	8
53	8.516726	9.999765	8.516961	11.483039	7
54	8.520551	9.999761	8.520790	11.479210	6
55	8.524343	9.999756	8.524586	11.475414	5
56	8.528102	9.999753	8.528349	11.471651	4
57	8.531828	9.999748	8.532080	11.467920	3
58	8.535523	9.999744	8.535779	11.464221	2
59	8.539186	9.999740	8.539447	11.460553	1
60	8.542819	9.999735	8.543084	11.456916	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 88.

M	Sine	Co-sine	Tangent	Co-tang.	
0	8.542819	9.999735	8.543084	11.456916	60
1	8.546422	9.999731	8.546691	11.453309	59
2	8.549995	9.999726	8.550268	11.449731	58
3	8.553558	9.999722	8.553817	11.446183	57
4	8.557054	9.999717	8.557336	11.442664	56
5	8.560540	9.999713	8.560827	11.439172	55
6	8.563999	9.999708	8.564291	11.435709	54
7	8.567431	9.999703	8.567727	11.432271	53
8	8.570836	9.999699	8.571137	11.428863	52
9	8.574214	9.999694	8.574520	11.425480	51
10	8.577566	9.999689	8.577877	11.422123	50
11	8.580893	9.999685	8.581208	11.418792	49
12	8.584193	9.999680	8.584514	11.415486	48
13	8.587469	9.999675	8.587795	11.412205	47
14	8.590721	9.999670	8.591051	11.408949	46
15	8.593948	9.999665	8.594283	11.405717	45
16	8.597152	9.999660	8.597492	11.402508	44
17	8.600332	9.999655	8.600677	11.399323	43
18	8.603488	9.999650	8.603838	11.396161	42
19	8.606622	9.999645	8.606978	11.393022	41
20	8.609734	9.999640	8.610094	11.389906	40
21	8.612823	9.999635	8.613189	11.386811	39
22	8.615891	9.999629	8.616262	11.383738	38
23	8.618937	9.999624	8.619313	11.380687	37
24	8.621967	9.999619	8.622343	11.377657	36
25	8.624965	9.999614	8.625352	11.374648	35
26	8.627948	9.999608	8.628340	11.371660	34
27	8.630911	9.999603	8.631308	11.368692	33
28	8.633862	9.999597	8.634256	11.365744	32
29	8.636776	9.999592	8.637184	11.362816	31
30	8.639679	9.999586	8.640093	11.359907	60

| | Co-sine | Sine | Co-tang. | Tangent | M |

M	Sine	Co-sine	Tangent	Co-Tang.	
30	8.639479	9.999586	8.640093	11.359907	30
31	8.642563	9.999581	8.642982	11.357017	29
32	8.645428	9.999575	8.645853	11.354147	28
33	8.648274	9.999570	8.648704	11.351296	27
34	8.651102	9.999564	8.651538	11.348463	26
35	8.653911	9.999558	8.654352	11.345648	25
36	8.656702	9.999553	8.657149	11.342851	24
37	8.659475	9.999547	8.659928	11.340072	23
38	8.662230	9.999541	8.662689	11.337311	22
39	8.664968	9.999535	8.665433	11.334567	21
40	8.669689	9.999529	8.668160	11.331840	20
41	8.670393	9.999523	8.670869	11.329120	19
42	8.673080	9.999518	8.673563	11.326437	18
43	8.675751	9.999512	8.676239	11.323761	17
44	8.678405	9.999506	8.678899	11.321100	16
45	8.681043	9.999499	8.681544	11.318456	15
46	8.683665	9.999493	9.684172	11.315828	14
47	8.686272	9.999487	8.686784	11.313216	13
48	8.688892	9.999481	8.689381	11.310619	12
49	8.691438	9.999475	8.691963	11.308037	11
50	8.693998	9.999469	8.694529	11.305471	10
51	8.696543	9.999462	8.697081	11.302919	9
52	8.699073	9.999456	8.699617	11.300383	8
53	8.701589	9.999450	8.702139	11.297861	7
54	8.704090	9.999443	8.704646	11.295354	6
55	8.706576	9.999437	8.707139	11.292860	5
56	8.709049	9.999431	8.709618	11.290381	4
57	8.711507	9.999424	8.712083	11.287917	3
58	8.713952	9.999418	8.714543	11.285466	2
59	8.716383	9.999411	8.716972	11.283028	1
60	8.718800	9.999404	8.719396	11.280604	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang	
0	8.718800	9.999404	8.719396	11.280604	60
1	8.721204	9.999398	8.721806	11.278194	59
2	8.723595	9.999391	8.724254	11.275746	58
3	8.725972	9.999384	8.726588	11.273412	57
4	8.728336	9.999378	8.728959	11.271041	56
5	8.730688	9.999371	8.731317	11.268683	55
6	8.733027	9.999364	8.733663	11.266337	54
7	8.735354	9.999357	8.735996	11.264004	53
8	8.737667	9.999350	8.738317	11.261683	52
9	8.739969	9.999343	8.740626	11.259374	51
10	8.742259	9.999336	8.742922	11.257078	50
11	8.744536	9.999329	8.745207	11.254793	49
12	8.746801	9.999322	8.747479	11.252521	48
13	8.745955	9.999315	8.749740	11.250240	47
14	8.751297	9.999308	8.751989	11.248011	46
15	8.753528	9.999301	8.754227	11.245773	45
16	8.755747	9.999294	8.756453	11.243547	44
17	8.757955	9.999286	8.758668	11.241332	43
18	8.760151	9.999279	8.760872	11.239128	42
19	8.762337	9.999272	8.763065	11.236935	41
20	8.764511	9.999265	8.765246	11.234754	40
21	8.766675	9.999257	8.767417	11.232583	39
22	8.768828	9.999250	8.769578	11.230422	38
23	8.770970	9.999242	8.771727	11.228273	37
24	8.773101	9.999235	8.773866	11.226134	36
25	8.775213	9.999227	8.775995	11.224005	35
26	8.777333	9.999220	8.778104	11.221886	34
27	8.779434	9.999212	8.783222	11.219778	33
28	8.781524	9.999204	8.782320	11.217680	32
29	8.783605	9.999197	8.784404	11.215592	31
30	8.785675	9.999189	8.786486	11.213514	60
	Co-sine	Sine	Co-tang.	Tangent	

M	Sine	Co-sine	Tangent	Co-ang.	
30	8.785675	9.999189	8.786486	11.213514	30
31	8.787736	9.999181	8.786554	11.211446	19
32	8.789787	9.999174	8.790613	11.209387	28
33	8.791828	9.999166	8.792662	11.207338	27
34	8.793859	9.999158	8.794701	11.205299	26
35	8.795881	9.999150	8.796731	11.203269	25
36	8.797894	9.999142	8.798752	11.201248	24
37	8.799897	9.999134	8.800763	11.199237	23
38	8.801891	9.999126	8.802765	11.197235	22
39	8.803876	9.999118	8.804758	11.195242	21
40	8.805852	9.999110	8.806742	11.193258	20
41	8.807819	9.999102	8.808717	11.191285	19
42	8.809777	9.999094	8.812683	11.189317	18
43	8.811726	9.999086	8.811641	11.187359	17
44	8.813667	9.999077	8.814589	11.185411	16
45	8.815598	9.999069	8.816529	11.183471	15
46	8.817522	9.999061	8.818461	11.181539	14
47	8.819436	9.999052	8.820384	11.179616	13
48	8.821342	9.999044	8.822298	11.177702	12
49	8.823240	9.999036	8.824205	11.175795	11
50	8.825130	9.999027	8.826103	11.173897	10
51	8.827011	9.999019	8.827992	11.172008	9
52	8.828884	9.999010	8.829874	11.170126	8
53	8.830749	9.999002	8.831748	11.168252	7
54	8.832606	9.998993	8.833613	11.166387	6
55	8.834456	9.998984	8.835471	11.164529	5
56	8.836297	9.998976	8.837321	11.162679	4
57	8.838130	9.998967	8.839163	11.160837	3
58	8.839956	9.998958	8.840998	11.159002	2
59	8.841774	9.998940	8.842825	11.157175	1
60	8.843585	9.998941	8.844644	11.155356	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 4.

M	Sine	Co-sine	Tangent	Co-tang.	
0	8.843584	9.998941	8.844649	11.155356	60
1	8.845387	9.998931	8.846455	11.153545	59
2	8.847183	9.998923	8.848240	11.151740	58
3	8.848971	9.998914	8.850057	11.149943	67
4	8.850751	9.998905	8.851846	11.148154	56
5	8.852525	9.998895	8.853628	11.146372	55
6	8.854291	9.998887	8.855403	11.144597	54
7	8.856049	9.998878	8.857171	11.142829	53
8	8.857801	9.998869	8.858922	11.141168	52
9	8.859546	9.998860	8.860686	11.139314	51
10	8.861283	9.998851	8.862433	11.137507	50
11	8.863014	9.998841	8.864173	11.135827	49
12	8.864738	9.998832	8.865906	11.134094	48
13	8.866454	9.998823	8.867632	11.132368	47
14	8.868165	9.998813	8.869351	11.130649	46
15	8.869868	9.998804	8.871064	11.128936	45
16	8.871565	9.998795	8.872770	11.127230	44
17	8.873255	9.998785	8.874469	11.125531	43
18	8.874938	9.998776	8.876162	11.123838	42
19	8.876615	9.998766	8.877849	11.122151	41
20	8.878285	9.998757	8.879529	11.120471	40
21	8.879949	9.998747	8.881202	11.118798	39
22	8.881607	9.998738	8.882869	11.117131	38
23	8.883258	9.998728	8.884530	11.115470	37
24	8.884903	9.998718	8.886185	11.113815	36
25	8.886542	9.998708	8.887833	11.112167	35
26	8.888174	9.998699	8.889476	11.110524	34
27	8.889801	9.998689	8.891112	11.108888	33
28	8.891421	9.998679	8.892742	11.107258	32
29	8.893035	9.998669	8.894366	11.105634	31
30	8.894643	9.998659	8.895984	11.104016	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 85.

M	Sine	Co-sine	Tangent	Co-tang.	
30	8.894643	9.998659	8.895946	11.104016	30
31	8.896246	9.998649	8.897596	11.102404	29
32	8.897842	9.998639	8.899203	11.100797	28
33	8.899432	9.998629	8.900803	11.099197	27
34	8.901017	9.998619	8.902398	11.097602	26
35	8.902596	9.998609	8.903987	11.096013	25
36	8.904169	9.998599	8.905570	11.094430	24
37	8.905736	9.998589	8.907147	11.092853	23
38	8.907297	9.998577	8.908719	11.091281	22
39	8.908853	9.998568	8.910285	11.089715	21
40	8.910404	9.998558	8.911846	11.088154	20
41	8.911949	9.998548	8.913401	11.086599	19
42	8.913488	9.998537	8.914951	11.085049	18
43	8.915022	9.998527	8.916495	11.083505	17
44	8.916550	9.998516	8.918034	11.081966	16
45	8.918073	9.998506	8.919568	11.080432	15
46	8.919591	9.998495	8.921096	11.078924	14
47	8.921103	9.998485	8.922619	11.077381	13
48	8.922610	9.998474	8.924136	11.075864	12
49	8.924112	9.998464	8.925649	11.074351	11
50	8.925609	9.998453	8.927156	11.072844	10
51	8.927100	9.998442	8.928658	11.071344	9
52	8.928587	9.998431	8.930155	11.069845	8
53	8.930068	9.998421	8.931647	11.068353	7
54	8.931544	9.998410	8.933134	11.066866	6
55	8.933015	9.998399	8.934616	11.065384	5
56	8.934481	9.998388	8.936093	11.063907	4
57	8.935942	9.998377	8.937565	11.062435	3
58	8.937398	9.998366	8.939032	11.060968	2
59	8.938850	9.998355	8.940494	11.059506	1
60	8.940296	9.998344	8.941952	11.058048	0
M	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	8.940296	9.998344	8.941952	11.058048	60
1	8.941738	9.998333	8.943404	11.056596	59
2	8.943174	9.998322	8.944852	11.055148	58
3	8.944606	9.998311	8.946295	11.053705	57
4	8.945234	9.998300	8.947734	11.052266	56
5	8.957456	9.998289	8.949168	11.050832	55
6	8.958814	9.998277	8.950597	11.049403	54
7	8.950287	9.998266	8.952021	11.047979	53
8	8.951696	9.998255	8.953441	11.046559	52
9	8.953099	9.998243	8.954856	11.245144	51
10	8.954499	9.998232	8.956267	11.043733	50
11	8.955804	9.998220	8.957074	11.042326	49
12	8.957284	9.998209	8.959075	11.040925	48
13	8.958670	9.998197	8.960473	11.039527	47
14	8.960052	9.998186	8.961866	11.038134	46
15	8.961429	9.998174	8.963254	11.036746	45
16	8.962801	9.998162	8.964639	11.035361	44
17	8.964170	9.998151	8.966019	11.033981	43
18	8.965534	9.998139	8.967394	11.032606	42
19	8.966893	9.998128	8.968766	11.031224	41
20	8.968249	9.998106	8.970133	11.029867	40
21	8.969600	9.998104	8.971495	11.028525	39
22	8.970947	9.998092	8.972855	11.027145	38
23	8.972289	9.998080	8.974209	11.025791	37
24	8.973626	9.998068	8.975560	11.024440	36
25	8.974961	9.998056	8.976906	11.023094	35
26	8.976293	9.998044	1.978248	11.021752	34
27	8.977619	9.998032	8.979586	11.020424	33
28	8.978941	9.998020	8.980921	11.019079	32
29	8.980259	9.998008	8.982251	11.017749	31
30	8.981573	9.997996	8.683577	11.016423	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	8.981573	9.997996	8.983577	11.010423	30
31	8.982883	9.997984	8.984899	11.015101	29
32	8.984189	9.997971	8.986217	11.013783	28
33	8.985491	9.997959	8.987532	11.012468	27
34	8.986789	9.997947	8.988842	11.011158	26
35	8.988082	9.997935	8.990149	11.009851	25
36	8.989374	9.997922	8.991451	11.008549	24
37	8.990660	9.997910	8.992750	11.007250	23
38	8.991943	9.997897	8.994045	11.005955	22
39	8.993228	9.997885	8.995337	11.004663	21
40	8.994497	9.997873	8.996624	11.003376	20
41	8.995768	9.997860	8.997908	11.002092	19
42	8.997036	9.997847	8.999188	11.000812	18
43	8.998299	9.997835	9.000465	10.999535	17
44	8.999560	9.997822	9.001738	10.998262	16
45	8.900816	9.997809	9.03007	10.996993	15
46	9.001069	9.997797	9.004272	10.995728	14
47	9.003318	9.997784	9.005534	10.994466	13
48	9.004163	9.997771	9.006792	10.993208	12
49	9.005805	9.997758	9.008047	10.991953	11
50	9.007044	9.997742	9.009298	10.990702	10
51	9.008278	9.997732	9.010546	10.989454	9
52	9.009510	9.997719	9.011790	10.988210	8
53	9.010737	9.997707	9.013031	10.986969	7
54	9.011962	9.997692	9.012268	10.985732	6
55	9.013182	9.997680	9.015502	10.984498	5
56	9.014399	9.997667	9.016732	10.983268	4
57	9.015613	9.997654	9.017959	10.982041	3
58	9.015824	9.997641	9.019183	10.980817	2
59	9.018031	9.997628	9.020403	10.979597	1
60	9.019235	9.997614	9.021620	10.978380	0
	Co-sine	Sine	Co-tang.	Tangent	M

E 4

Degree 6.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.019235	9.997614	9.021620	10.978380	60
1	9.020435	9.997601	9.012834	10.977166	59
2	9.021632	9.9975$8	9.024044	10.975956	58
3	9.022825	9.997574	9.025251	10.974749	57
4	9.024016	9.997562	9.026455	10.973545	56
5	9.025203	9.997548	9.027655	10.972345	55
6	9.025356	9.997534	9.028852	10.971148	54
7	9.0.7567	9.997520	9.030045	10.969954	53
8	9.028744	9.997507	9.031237	10.968763	52
9	9.029918	9.997493	9.032425	10.967575	51
10	9.031089	9.9974.0	9.033609	10.966391	50
11	9.032257	9.997466	9.034791	10.965209	49
12	9.033421	9.997452	9.035969	10.964031	48
13	9.034582	9.997439	9.037144	10.962856	47
14	9.035741	9.997425	9.038316	10.961684	46
15	9.036896	9.997411	9.039485	10.960515	45
16	9.038048	9.997397	9.040651	10.959349	44
17	9.039197	9.997383	9.041813	10.958187	43
18	9.040342	9.997369	9.042973	10.957027	42
19	9.041485	9.997355	9.044130	10.955870	41
20	9.042625	9.997341	9.045284	10.954716	40
21	9.043762	9.997327	9.045434	10.953566	39
22	9.044895	9.997313	9.047582	10.952418	38
23	9.046026	9.997299	9.048727	10.951273	37
24	9.047154	9.997285	9.049869	10.950131	36
25	9.048279	9.997271	9.051008	10.948992	35
26	9.049400	9.997256	9.052144	10.947856	34
27	9.052509	9.997242	9.053277	10.946723	33
28	9.051635	9.997228	9.054408	10.945592	32
29	9.052709	9.997214	9.055535	10.944465	31
30	9.053859	9.997199	9.056640	10.943340	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 83.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.053859	9.997199	9.0566.0	10.943340	30
31	9.054966	9.997185	9.057781	10.9422.9	29
32	9.056071	9.997170	9.058900	10.941100	28
33	9.057172	9.997156	9.060016	10.939984	27
34	9.0.8271	9.997141	9.061132	10.938870	26
35	9.059367	9.997127	9.062240	10.937700	25
36	9.060460	9.997112	9.063348	10.936652	24
37	9.061551	9.997098	9.064453	10.935547	23
38	9.062638	9.997083	9.065556	10.934444	22
39	9.063723	9.997068	9.066655	10.933345	21
40	9.064806	9.997053	9.067752	10.932248	20
41	9.065885	9.997039	9.0688.7	10.931153	19
42	9.066962	9.997024	9.069938	10.930062	18
43	9.068036	9.997009	9.071027	10.928973	17
44	9.069107	9.996994	9.072113	10.927887	16
45	9.070176	9.996979	9.073197	10.926803	15
46	9.071242	9.996964	9.074278	10.925722	14
47	9.072306	9.996949	9.075356	10.924644	13
48	9.073366	9.996934	9.076432	10.923568	12
49	9.074424	9.996919	9.077505	10.922495	11
50	9.075480	9.996904	9.078576	10.921414	10
51	9.076523	9.996889	9.079644	10.920356	9
52	9.077583	9.996874	9.080710	10.919290	8
53	9.078631	9.996858	9.081773	10.918227	7
54	9.079676	9.996843	9.082833	10.917167	6
55	9.080719	9.996828	9.083891	10.916109	5
56	9.081759	9.996812	9.084947	10.915053	4
57	9.082797	9.996797	9.085999	10.914000	3
58	9.083832	9.996782	9.087050	10.912950	2
59	9.084864	9.996766	9.088098	10.911902	1
60	9.085894	9.996751	9.089144	10.910856	0
	Co-sine	Sine	Co-ting.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.085894	9.996751	9.089144	10.910876	60
1	9.086922	9.996735	9.090187	10.909813	59
2	9.087947	9.996720	9.091228	10.908772	58
3	9.088970	9.996704	9.092266	10.907734	57
4	9.089990	9.996688	9.093302	10.906698	56
5	9.091088	9.996673	9.094336	10.905664	55
6	9.092024	9.996657	9.095367	10.904633	54
7	9.093037	9.996641	9.096395	10.903604	53
8	9.094047	9.996625	9.097422	10.902578	52
9	9.095056	9.996610	9.098446	10.901554	51
10	9.096062	9.996594	9.099468	10.900532	50
11	9.097065	9.996578	9.100487	10.899513	49
12	9.098066	9.996562	9.101504	10.898496	48
13	9.099065	9.996546	9.102519	10.897481	47
14	9.100062	9.996530	9.103532	10.896468	46
15	9.101056	9.996514	9.104542	10.895458	45
16	9.102048	9.996498	9.105550	10.894450	44
17	9.103037	9.996482	9.106556	10.893444	43
18	9.104025	9.996465	9.107559	10.892441	42
19	9.105010	9.996449	9.108560	10.891440	41
20	9.105992	9.996433	9.109559	10.890441	40
21	9.106973	9.996417	9.110556	10.889444	39
22	9.107951	9.996400	9.111551	10.888449	38
23	9.108927	9.996384	9.112543	10.887457	37
24	9.109901	9.996368	9.113533	10.886467	36
25	9.110873	9.996351	9.114521	10.885478	35
26	9.111842	9.996335	9.115507	10.884493	34
27	9.112809	9.996318	9.116491	10.883509	33
28	9.113774	9.996302	9.117472	10.882528	32
29	9.114737	9.996285	9.118452	10.881548	31
30	9.115698	9.996269	9.119429	10.880571	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Cot-ang.	
30	9.113698	9.996269	9.114427	10.880571	30
31	9.116656	9.996252	9.120404	10.879595	29
32	9.117612	9.996235	9.121377	10.878623	28
33	9.118567	9.996218	9.122348	10.877652	27
34	9.119519	9.996202	9.123317	10.876683	26
35	9.120469	9.996185	9.124284	10.875716	25
36	9.121417	9.996168	9.125248	10.874751	24
37	9.122362	9.996152	9.126211	20.873789	23
38	9.123306	9.996134	9.127172	10.872828	22
39	9.124248	9.996117	9.128130	10.871870	21
40	9.125187	9.996100	9.129087	10.870913	20
41	9.126125	9.996083	9.130041	10.869959	19
42	9.127060	9.996066	9.130994	10.869006	18
43	9.127993	9.996049	9.131944	10.868056	17
44	9.128925	9.996032	9.132893	10.867107	16
45	9.129854	9.996015	9.133839	10.866161	15
46	9.130781	9.995998	9.134784	10.865216	14
47	9.131706	9.995980	9.135726	10.864274	13
48	9.132630	9.995963	9.136666	10.863334	12
49	9.133551	9.995946	9.137605	10.862395	11
50	9.134470	9.995928	9.138542	10.861458	10
51	9.135387	9.995911	9.139476	10.860524	9
52	9.136303	9.995894	9.140409	10.859591	8
53	9.137216	9.995876	9.141340	10.858660	7
54	9.138127	9.995859	9.142269	10.857731	6
55	9.139037	9.995841	9.143196	10.856804	5
56	9.139944	9.995825	9.144121	10.855879	4
57	9.140850	9.995806	9.145044	10.854956	3
58	9.141754	9.995788	9.145965	10.854035	2
59	9.142655	9.995770	9.146885	10.853115	1
60	9.143555	9.995753	9.147803	10.852197	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.143555	9.995753	9.147803	10.852197	60
1	9.144453	9.995735	9.148718	10.851282	59
2	9.145349	9.995717	9.149632	10.850368	58
3	9.146243	9.995699	9.150544	10.849456	57
4	9.147136	9.995681	9.151454	10.848545	56
5	9.148026	9.995664	9.152363	10.847637	55
6	9.148915	9.995646	9.153269	10.846731	54
7	9.149801	9.995628	9.154174	10.845825	53
8	9.150686	9.995610	9.155077	10.844923	52
9	9.151569	9.995591	9.155978	10.844022	51
10	9.152451	9.995573	9.156877	10.843123	50
11	9.153330	9.995555	9.157775	10.842225	49
12	9.154208	9.995537	9.158671	10.841329	48
13	9.155082	9.995519	9.159565	10.840435	47
14	9.155957	9.995501	9.160457	10.839543	46
15	9.156830	9.995482	9.161347	10.838653	45
16	9.157700	9.995464	9.162236	10.837764	44
17	9.158569	9.995446	9.163123	10.836877	43
18	9.159436	9.995427	9.164008	10.835992	42
19	9.160301	9.995409	9.164892	10.835108	41
20	9.161164	9.995390	9.165773	10.834225	40
21	9.162029	9.995272	9.166654	10.833346	39
22	9.162885	9.995353	9.167532	10.832468	38
23	9.163743	9.995334	9.168409	10.831591	37
24	9.164600	9.995316	9.169284	10.830716	36
25	9.165454	9.995297	9.170157	10.829843	35
26	9.166307	9.995278	9.171029	10.828971	34
27	9.167158	9.995260	9.171899	10.828101	33
28	9.168008	9.995241	9.172767	10.827233	32
29	9.168856	9.995222	9.173633	10.826366	31
30	9.169702	9.995203	9.174499	10.825501	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.169702	9.995205	9.174499	10.825501	30
31	9.170546	9.995184	9.175362	10.824638	29
32	9.171389	9.995165	9.176224	10.823776	28
33	9.172230	9.995146	9.177084	10.822916	27
34	9.173070	9.995127	9.177942	10.822057	26
35	9.173908	9.995108	9.178799	10.821201	25
36	9.174744	9.995089	9.179655	10.820345	24
37	9.175578	9.995070	9.180508	10.819492	23
38	9.176411	9.995061	9.181360	10.818640	22
39	9.177242	9.995032	9.182211	10.817789	21
40	9.178072	9.995012	9.183060	10.816940	20
41	9.178900	9.994993	9.183907	10.816093	19
42	9.179726	9.994974	9.184752	10.815248	18
43	9.180551	9.994955	9.185597	10.814403	17
44	9.181374	9.994935	9.186439	10.813561	16
45	9.182196	9.994916	9.187280	10.812720	15
46	9.183016	9.994896	9.188120	10.811880	14
47	9.183834	9.994876	9.188957	10.811042	13
48	9.184651	9.994857	9.189794	10.810206	12
49	9.185466	9.994838	9.190629	10.809371	11
50	9.186280	9.994818	9.191462	10.808538	10
51	9.187092	9.994798	9.192294	10.807706	9
52	9.187903	9.994779	9.193124	10.806876	8
53	9.188712	9.994759	9.193953	10.806047	7
54	9.189519	9.994739	9.194780	10.805220	6
55	9.190325	9.994719	9.195606	10.804394	5
56	9.191130	9.994699	9.196430	10.803570	4
57	9.191933	9.994680	9.197253	10.802747	3
58	9.192734	9.994660	9.198074	10.801926	2
59	9.193534	9.994640	9.198894	10.801106	1
60	9.194332	9.994620	9.199712	10.800287	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
0	5.194332	9.994620	9.199712	10.800187	60
1	9.195129	9.994600	9.200529	10.799470	59
2	9.195925	9.994580	9.201345	10.798655	58
3	9.196718	9.994560	9.202159	10.797841	57
4	9.197511	9.994540	9.202971	10.797029	56
5	9.198302	9.994519	9.203782	10.796218	55
6	9.199091	9.994499	9.204592	10.795408	54
7	9.199879	9.994479	9.205400	10.794600	53
8	9.200666	9.994458	9.206207	10.793793	52
9	9.201451	9.994438	9.207013	10.792987	51
10	9.202234	9.994418	9.207817	10.792183	50
11	9.203017	9.994398	9.208619	10.791381	49
12	9.203797	9.994377	9.209420	10.790580	48
13	9.204577	9.994357	9.210220	10.789780	47
14	9.205354	9.994336	9.211018	10.788982	46
15	9.206131	9.994316	9.211815	10.788185	45
16	9.206906	9.994295	9.212611	10.787389	44
17	9.207679	9.994274	9.213405	10.786595	43
18	9.208452	9.994254	9.214198	10.785802	42
19	9.209222	9.994233	9.214989	10.785011	41
20	9.209992	9.994212	9.215780	10.784220	40
21	9.210760	9.994191	9.216568	10.783432	39
22	9.211516	9.994171	9.217356	10.782644	38
23	9.212291	9.994150	9.218142	10.781858	37
24	9.213055	9.994129	9.218926	10.781074	36
25	9.213818	9.994108	9.219710	10.780290	35
26	9.214578	9.994087	9.220491	10.779508	34
27	9.215338	9.994066	9.221272	10.778728	33
28	9.216097	9.994044	9.222052	10.777948	32
29	9.216854	9.994023	9.222830	10.777170	31
30	9.217609	9.994003	9.223607	10.776393	30
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.217609	9.994003	9.223607	10.716393	30
31	9.218363	0.993982	6.224382	10.775618	29
32	9.219116	9.993960	9.225156	10.774844	28
33	9.219868	9.993939	9.225929	10.774071	27
34	9.220618	9.993918	9.226704	10.773300	26
35	9.221367	9.993897	9.227471	10.772529	25
36	9.222115	9.993875	9.228240	10.771760	24
37	9.222861	9.993854	9.229007	10.770993	23
38	9.223606	9.993833	9.229774	10.770226	22
39	9.224349	9.993811	9.230539	30.769461	21
40	9.225092	9.993789	9.231302	10.768698	20
41	9.225853	9.993768	9.232065	10.767935	19
42	9.226573	9.993746	9.232826	10.767174	18
43	6.227311	9.993725	9.233586	10.766414	17
44	9.228048	9.993703	9.234345	10.765655	16
45	9.228784	0.993681	9.235103	10.764897	15
46	9.229518	9.993660	9.235859	10.764141	14
47	9.230252	9.993638	9.236614	10.763386	13
48	6.230984	9.993616	9.237368	10.762632	12
49	6.231715	9.993594	9.238120	10.761880	11
50	9.232444	9.993572	9.238872	10.761128	10
51	9.233172	9.993550	9.239622	10.760378	9
52	9.233899	9.993528	9.240371	10.759629	8
53	9.234625	9.993506	9.241118	10.758882	7
54	9.235349	9.993484	9.241865	10.758135	6
55	9.236073	9.993462	9.242610	10.757390	5
56	9.236795	9.993440	9.243354	10.756646	4
57	9.237515	9.993418	9.244097	10.755903	3
58	9.238835	9.993396	9.244839	10.755161	2
59	9.238952	9.993374	9.245579	10.754421	1
60	9.239670	9.993351	9.246319	10.753681	0
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.239670	9.993251	9.246319	10.753081	60
1	9.240386	9.993329	9.247057	10.752943	59
2	9.241101	9.993307	9.247794	10.752206	58
3	9.241814	9.993284	9.248530	10.751470	57
4	9.242526	9.993262	9.249264	10.750736	56
5	9.243237	9.993240	9.249998	10.750002	55
6	9.243947	9.993117	9.250730	10.749270	54
7	9.244656	9.993195	9.251461	10.748539	53
8	9.245363	9.993172	9.252191	10.747809	52
9	9.246070	9.993149	9.252920	10.747080	51
10	9.246775	9.993127	9.253648	10.746152	50
11	9.247478	9.993104	9.254374	10.745026	49
12	9.248181	9.993081	9.255100	10.744900	48
13	9.248883	9.993059	9.255824	10.744176	47
14	9.249583	9.993036	9.256547	10.743453	46
15	9.250282	9.993013	9.257269	10.742731	45
16	9.250980	9.992990	9.257990	10.742010	44
17	9.251677	9.992967	9.258710	10.741290	43
18	9.252373	9.992944	9.259429	10.740571	42
19	9.253067	9.992921	9.260146	10.739854	41
20	9.253761	9.992898	9.260863	10.739137	40
21	9.254453	9.992873	9.261578	10.738422	39
22	9.255144	9.992852	9.262292	10.737708	38
23	9.255834	9.992829	9.263005	10.736995	37
24	9.256523	9.992806	9.263717	10.736283	36
25	9.257211	9.992783	9.264428	10.735572	35
26	9.257898	9.992759	9.265138	10.734862	34
27	9.258583	9.992736	9.265847	10.734153	33
28	9.259268	9.992613	9.266555	10.733445	32
29	9.259952	9.992690	9.267261	10.732739	31
30	9.260633	9.992666	9.267967	10.732033	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.260633	9.992666	9.267967	10.732033	30
31	9.261214	9.992643	9.268671	10.731329	19
32	9.261994	9.992619	9.269375	10.730625	18
33	9.262673	9.992596	9.270778	10.729923	27
34	9.263351	9.992572	9.271479	10.729221	26
35	9.264027	9.992549	9.271479	10.728521	25
36	9.264702	9.992525	9.272178	10.727822	24
37	9.265378	9.992501	9.272876	10.727124	23
38	9.266051	9.992478	9.273573	10.726427	22
39	9.266723	9.992454	9.274269	10.725731	21
40	9.267395	9.992430	9.274964	10.725036	20
41	9.268065	9.992406	9.275658	10.724342	19
42	9.268734	9.992382	9.276351	10.723649	18
43	9.269402	9.992362	9.277043	10.722957	17
44	9.270069	9.992335	9.277734	10.722266	16
45	9.270735	9.992311	9.278424	10.721576	15
46	9.271400	9.992287	9.279113	10.720887	14
47	9.272063	9.992263	9.279801	10.720199	13
48	9.272726	9.992239	9.280488	10.719512	12
49	9.273388	9.992214	9.281174	10.718826	11
50	9.274049	9.992190	9.281858	10.718142	10
51	9.274708	9.992166	9.282542	10.717458	9
52	9.275367	9.992142	9.283225	10.716775	8
53	9.276025	9.992118	9.283907	10.716093	7
54	9.276681	9.992093	9.284588	10.715412	6
55	9.277337	9.992069	9.285268	10.714732	5
56	9.277992	9.992045	9.285946	10.714053	4
57	9.278685	9.992020	9.286624	10.713376	3
58	9.279197	9.991996	9.287301	10.712699	2
59	9.279918	9.991971	9.287977	10.712023	1
60	9.280599	9.991947	9.288652	10.711348	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.280599	9.991947	9.288652	10.711348	60
1	9.281229	9.991922	9.289326	10.710674	59
2	9.281897	9.991897	9.289999	10.710001	58
3	9.282544	9.991873	9.290671	10.709329	57
4	9.183190	9.991848	9.291342	10.708658	56
5	9.283836	9.991823	9.292013	10.707987	55
6	9.284480	9.991799	9.292682	10.707318	54
7	9.285124	9.991774	9.293350	10.706650	53
8	9.285766	9.991749	9.294017	10.705983	52
9	9.286408	9.991724	9.294684	10.705316	51
10	9.287048	9.991699	9.295349	10.704651	50
11	9.287688	9.991674	9.296013	10.703987	49
12	9.288326	9.991649	9.296677	10.703323	48
13	9.288964	9.991624	9.297339	10.702661	47
14	9.289600	9.991599	9.298001	10.701999	46
15	9.290236	9.991574	9.298662	10.701338	45
16	9.290870	9.991549	9.299322	10.700678	44
17	9.291504	9.991524	9.299980	10.700020	43
18	9.292137	9.991498	9.300638	10.699362	42
19	9.292768	9.991473	9.301295	10.698705	41
20	9.293399	9.991448	9.301951	10.698049	40
21	9.294029	9.991422	9.302607	10.697393	39
22	9.294658	9.991397	9.303261	10.696739	38
23	9.295286	9.991372	9.303914	10.696086	37
24	9.295913	9.991346	9.304567	10.695433	36
25	9.296539	9.991321	9.305218	10.694782	35
26	9.297164	9.991295	9.305867	10.694131	34
27	9.297788	9.991270	9.306519	10.693481	33
28	9.298412	9.991244	9.307168	10.692832	32
29	9.299034	9.991218	9.307816	10.691184	31
30	9.299655	9.991193	9.308463	10.691537	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.299655	9.991193	9.308463	10.691537	30
31	9.300276	9.991167	9.309109	10.690891	29
32	9.300895	9.991141	9.309754	10.690246	28
33	9.301514	9.991115	9.310399	10.689601	27
34	9.302132	9.991090	9.311042	10.688958	26
35	9.302749	9.991064	9.311685	10.688315	25
36	9.303364	9.991038	9.312327	10.687673	24
37	9.303979	9.991012	9.312968	10.687032	23
38	9.304593	9.990986	9.313608	10.686392	22
39	9.305207	9.990960	9.314247	10.685753	21
40	9.305819	9.990934	9.314885	10.685115	20
41	9.306430	9.990908	9.315523	10.684477	19
42	9.307041	9.990882	9.316159	10.683841	18
43	9.307650	9.990855	9.316795	10.683205	17
44	9.308259	9.990829	9.317430	10.682570	16
45	9.308867	9.990803	9.318064	10.681936	15
46	9.309474	9.990777	9.318697	10.681303	14
47	9.310080	9.990750	9.319330	10.680670	13
48	9.310685	9.990724	9.319961	10.680039	12
49	9.311289	9.990697	9.320592	10.679408	11
50	9.311899	9.990671	9.321222	10.678778	10
51	9.312495	9.990645	9.321851	10.678149	9
52	9.313097	9.990618	9.322479	10.677521	8
53	9.313698	9.990591	9.323106	10.676894	7
54	9.314297	9.990565	9.323733	10.676267	6
55	9.314897	9.990538	9.324358	10.675642	5
56	9.315495	9.990512	9.324983	10.675017	4
57	9.316092	9.990485	9.325607	10.674393	3
58	9.316689	9.990458	9.326231	10.673769	2
59	9.317284	9.990431	9.326853	10.673147	1
60	9.317879	9.990404	9.327475	10.672515	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.317879	9.990404	9.327475	10.672525	60
1	9.318473	9.990477	9.328095	10.671905	59
2	9.319066	9.990351	9.328715	10.671285	58
3	9.319658	9.990324	9.329334	10.670666	57
4	9.322250	9.990297	9.329953	10.670047	56
5	9.320840	9.990270	9.320570	10.669430	55
6	9.321430	9.990242	9.331187	10.668813	54
7	9.322019	9.990215	9.331803	10.668197	53
8	9.322607	9.990188	9.332418	10.667582	52
9	9.323194	9.990161	9.33.033	10.666967	51
10	9.323780	9.990134	9.333646	10.666354	50
11	9.324366	9.990107	9.334259	10.665741	49
12	9.324950	9.990079	9.334871	10.665129	48
13	9.325534	9.990052	9.335482	10.664518	47
14	9.326117	9.990025	9.336093	10.663907	46
15	9.326699	9.989997	9.336702	10.663298	45
16	9.327281	9.989970	9.337312	10.662689	44
17	9.327862	8.989942	9.337919	10.662081	43
18	9.328441	9.989915	9.338527	10.661473	42
19	9.329020	9.989887	9.339133	10.660817	41
20	9.329599	9.989860	9.339739	10.660261	40
21	9.330176	9.989832	9.340344	10.659656	39
22	9.330753	9.989804	9.340948	10.659052	38
23	9.331328	9.989777	9.341552	10.658448	37
24	9.331903	9.989749	9.342155	10.657845	36
25	9.332478	9.989721	9.342757	10.657243	35
26	9.333051	9.989693	9.343358	10.656642	34
27	9.333624	9.989665	9.343958	10.656042	33
28	9.334195	9.989637	9.344558	10.655442	32
29	9.334766	9.989609	9.345157	10.654843	31
30	9.335337	9.989581	9.345755	10.654245	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.335337	9.989581	9.345755	10.654245	30
31	9.335906	9.989553	9.346353	10.653647	29
32	9.336475	9.989525	9.346949	10.653051	28
33	9.337043	9.989597	9.347545	10.652455	27
34	9.337610	9.989469	9.348141	10.651859	26
35	9.338176	9.989441	9.348735	10.651265	25
36	9.338742	9.987413	9.349329	10.650671	24
37	9.339306	9.989384	9.349922	10.650078	23
38	9.339870	9.989356	9.350514	10.649486	22
39	9.340434	9.989328	9.351106	10.648894	21
40	9.340996	9.989299	9.351697	10.648303	20
41	9.341558	9.989271	9.352287	0.647713	19
42	9.342119	9.989243	9.352876	10.647124	18
43	9.342679	9.989214	9.353465	10.646535	17
44	9.343239	9.989186	9.354053	10.645947	16
45	9.343797	9.989157	9.354640	10.645360	15
46	9.344355	9.989128	9.355227	10.644773	14
47	9.344912	9.989100	9.355812	0.644187	13
48	9.345469	9.989071	9.356398	10.643602	12
49	9.346024	9.989042	9.356982	10.643018	11
50	9.346579	9.989014	9.357566	10.642434	10
51	9.347134	9.988985	9.358149	10.641851	9
52	9.347687	9.988956	9.358731	10.641169	8
53	9.348240	9.988927	9.359323	10.640687	7
54	9.348792	9.988898	9.359893	10.640107	6
55	9.349343	9.988869	9.360474	10.639526	5
56	9.349893	9.988840	9.361053	10.638947	4
57	9.350443	9.988811	9.361632	10.628369	3
58	9.350992	9.988781	9.362210	10.637790	2
59	9.351540	9.988754	9.362787	10.637213	1
60	9.352088	9.988724	9.361364	10.636636	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.352088	9.988724	9.363364	10.636636	60
1	9.352635	9.988695	9.363940	10.636050	59
2	9.353181	9.988666	9.364515	10.635485	58
3	9.353726	9.988636	9.365090	10.634910	57
4	9.354271	9.988607	9.365664	10.634336	56
5	9.354185	9.988578	9.366237	10.633763	55
6	9.355358	9.988548	9.366810	10.633190	54
7	9.355901	9.988519	9.367382	10.632618	53
8	9.356443	9.988489	9.367953	10.632047	52
9	9.356984	9.988460	9.368524	10.631476	51
10	9.357524	9.988430	9.369094	10.630906	50
11	9.358064	9.988401	9.369663	10.630337	49
12	9.358603	9.988371	9.370232	13.629768	48
13	9.359141	9.988341	9.370799	10.629201	47
14	9.359679	9.988312	9.371367	10.628633	46
15	9.360215	9.988282	9.371933	10.628067	45
16	9.360752	9.988252	9.372499	10.627501	44
17	9.361287	9.988223	9.373064	10.626936	43
18	9.361822	9.988193	9.373629	10.626371	42
19	9.362356	9.988163	9.374193	10.625807	41
20	9.362889	9.988133	9.374756	10.625214	40
21	9.363422	9.988103	9.375319	10.624681	39
22	9.363954	9.988073	9.375881	10.624119	38
23	9.364485	9.988043	9.376442	10.613558	37
24	9.365016	9.988013	9.377003	10.622997	36
25	9.365546	9.987983	9.377562	10.622437	35
26	9.366075	9.987953	9.378122	10.621878	34
27	9.366604	9.987922	9.378681	10.621319	33
28	9.367132	9.987892	9.379239	10.620761	32
29	9.367659	9.987862	9.379797	10.620203	31
30	9.368185	9.987832	9.380354	10.619646	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang,	
30	9.368185	9.987832	9.380354	10.619646	30
31	9.368711	9.987801	9.380910	10.619090	29
32	9.369236	9.987771	9.381466	10.618534	28
33	9.369761	9.987742	9.382021	10.617980	27
34	9.370285	9.987710	9.382575	10.617425	26
35	9.370808	9.987679	9.383129	10.616871	25
36	9.371330	9.987649	9.383682	10.616318	24
37	9.371852	9.987618	9.384234	10.615766	23
38	9.372373	9.987588	9.384786	10.615214	22
39	9.372894	9.987557	9.385337	10.614663	21
40	9.373414	9.987526	9.385888	10.614112	20
41	9.373933	9.987496	9.386438	10.613562	19
42	9.374452	9.987465	9.386987	10.613013	18
43	9.374970	9.987434	9.387536	10.612464	17
44	9.375487	9.987403	9.388084	10.611916	16
45	9.376003	9.987372	9.288631	10.611369	15
46	9.376519	9.987341	9.389178	10.610822	14
47	6.377025	9.987310	9.389724	10.610276	13
48	9.377549	9.987279	9.390270	10.609730	12
49	9.378053	9.987248	9.390815	10.609185	11
50	9.378577	9.987217	9.391360	10.608640	10
51	9.379089	9.987186	9.391907	10.608097	9
52	9.379601	9.987155	9.392467	10.607553	8
53	9.380113	9.987124	9.392989	10.607011	7
54	9.380624	9.987092	9.393531	10.606469	6
55	9.381134	9.987061	9.394074	10.605927	5
56	9.381643	9.987030	9.394614	10.605386	4
57	9.382152	9.986998	9.395154	10.604846	3
58	9.382661	9.986967	9.395694	10.604306	2
59	9.383168	9.986936	9.396233	10.603767	1
60	9.383675	9.986904	9.396771	10.603229	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.383675	9.986904	9. 96771	10.6 3229	60
1	9.384181	9.986873	9.397309	10.602694	59
2	9.384687	9.986841	9.397846	10.602154	58
3	9.385192	9.986809	9.398383	10.601617	57
4	9.385697	9.986778	9.398919	10.601081	56
5	9.386201	9.986746	9.399455	10.600545	55
6	9.386704	9.986714	9.399990	10.600010	54
7	9.387207	9.986683	9.400524	10.599476	53
8	9.387709	9.986651	9.401058	10.598942	52
9	9.388210	9.986619	9.401591	10.598409	51
10	9.388711	9.985587	9.402124	10.597876	50
11	9.389211	9.986555	9.402656	10.597344	49
12	9.389711	9.986523	9.403187	10.596812	48
13	9.390210	9.986491	9.403718	10.596282	47
14	9.390708	9.986459	9.404249	10.595751	46
15	9.391206	9.986427	9.404778	10.595222	45
16	9.391703	9.986395	9 405306	10.594692	44
17	9.392199	9.986362	9.405836	10.594164	43
18	9.392695	9.986338	9.406364	10.593636	42
19	9.393192	9.986299	9.405892	10.593608	41
20	9.393685	9.986266	9.407419	10.592581	40
21	9.394179	9.986234	9.407945	10.592055	39
22	9.394673	9.986201	9.408471	10.591529	38
23	9.395166	9.986169	9.408996	10 591001	37
24	9.395654	9.986137	9.409521	10.590479	36
25	9.396150	9.986104	9.410045	10.589954	35
26	9.396641	9.986072	9.410559	10.589431	34
27	9.397131	9.986039	9.411092	10 588908	33
28	9.397621	9.986007	9.411615	10 588385	32
29	9.398111	9.985974	9.412137	10.587861	31
30	9.398600	9.985942	9 41268	10.587342	30

	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
	9.398603	9.985942	9.412658	10.587342	30
	9.399287	9.985909	9.413179	10.586821	29
	9.399575	9.985876	9.413699	10.586201	28
	9.400061	9.985843	9.414219	10.585781	27
	9.400549	9.985811	9.414738	10.585262	26
	9.401035	9.985778	9.415257	10.584742	25
	9.401520	9.985745	9.415775	10.584225	24
	9.402005	9.985712	9.416293	10.583707	23
	9.402489	9.985679	9.416810	10.583190	22
	9.402972	9.985646	9.417326	10.582674	21
	9.403455	9.985613	9.417842	10.582157	20
	9.403938	9.985580	9.418357	10.581642	19
	9.404420	9.985547	9.418873	10.581127	18
	9.404901	9.985513	9.419387	10.586613	17
	9.405382	9.985480	9.419901	10.580099	16
	9.405862	9.985447	9.420415	10.579585	15
	9.406341	9.985414	9.420927	10.579072	14
	9.406820	9.985380	9.421440	10.578560	13
	9.407299	9.985347	9.421951	10.578048	12
	9.407776	9.985314	9.422463	10.577537	11
	9.408254	9.985280	9.422973	10.577026	10
	9.408731	9.985247	9.423484	10.576516	9
	9.409207	9.985212	9.423993	10.576007	8
	9.409682	9.985180	9.424502	10.575497	7
	9.410157	9.985145	9.425011	10.574989	6
	9.410632	9.985112	9.425518	10.574480	5
	9.411106	9.985079	9.426027	10.573973	4
	9.411579	9.985045	9.426534	10.573466	3
	9.412052	9.985011	9.427041	10.572959	2
	9.412524	9.984977	9.427547	10.572453	1
	9.412996	9.984943	9.428052	10.571947	
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.412996	9.984944	9.428052	10.571947	60
1	9.413467	9.984910	9.428557	10.571442	59
2	9.413938	9.984876	9.429067	10.570938	58
3	9.414408	9.984842	9.429566	10.570434	57
4	9.414878	9.984808	9.430070	10.569930	56
5	9.415347	9.984774	9.430573	10.569427	55
6	9.415815	9.984740	9.431075	10.568925	54
7	9.416283	9.984706	9.431577	10.568423	53
8	9.416350	9.984672	9.432079	10.567921	52
9	9.417217	9.984637	9.432580	10.567420	51
10	9.417684	9.984603	9.433080	10.566920	50
11	9.418149	9.984569	9.433580	10.566420	49
12	9.418615	9.984535	9.434080	10.565920	48
13	9.419079	9.984500	9.434579	10.565421	47
14	9.419544	9.984466	9.435078	10.564922	46
15	9.420007	9.984431	9.435576	10.564424	45
16	9.420470	9.984397	9.436073	10.563927	44
17	9.420923	9.984363	9.436570	10.563430	43
18	9.421395	9.984328	9.437067	10.562933	42
19	9.421856	9.984293	9.437563	10.562437	41
20	9.422317	9.984259	9.438059	10.561941	40
21	9.422778	9.984224	9.438554	10.561446	39
22	9.423238	9.984189	9.439048	10.560952	38
23	9.423697	9.984155	9.439543	10.560457	37
24	9.424156	9.984120	9.440036	10.559964	36
25	9.424615	9.984085	9.440529	10.559471	35
26	9.425072	9.984050	9.441022	10.558978	34
27	9.425530	9.984015	9.441514	10.558486	33
28	9.425987	9.983980	9.442006	10.557994	32
29	9.426443	9.983945	9.442497	10.557503	31
30	9.426899	9.983910	9.442988	10.557011	30
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
30	9.426899	9.983910	9.442988	10.557011	30
31	9.427354	9.983875	9.443479	10.556521	29
32	9.427809	9.983840	9.443968	10.556031	28
33	9.428264	9.983805	9.444458	10.555542	27
34	9.428717	9.983770	9.444947	10.555053	26
35	9.429170	9.983735	9.445435	10.554565	25
36	9.429623	9.983699	9.445923	10.554077	24
37	9.430075	9.983664	9.446411	10.553589	23
38	9.430507	9.983629	9.446898	10.553102	22
39	9.430978	9.983593	9.447384	10.552616	21
40	9.431429	9.983558	9.447870	10.552129	20
41	9.431879	9.983523	9.448256	10.551644	19
42	9.432328	9.983487	9.448841	10.551159	18
43	9.432778	9.983452	9.449326	10.550674	17
44	9.433206	9.983416	9.449810	10.550181	16
45	9.433674	9.983380	9.450294	10.549706	15
46	9.434122	9.983345	9.450777	10.549213	14
47	9.434569	9.983309	9.451260	15.548740	13
48	9.435016	9.983272	9.451743	10.548257	12
49	9.435462	9.983238	9.452225	10.547775	11
50	9.435918	9.983202	9.452706	10.547294	10
51	9.436353	9.983166	9.453187	10.546813	9
52	9.436798	9.983130	9.453668	10.546332	8
53	9.437242	9.983094	9.454148	10.545852	7
54	9.437686	9.983058	9.454629	10.545371	6
55	9.438129	9.983022	9.455107	10.544893	5
56	9.438572	9.982986	9.455586	10.544414	4
57	9.439014	9.982950	9.456054	10.543936	3
58	9.439456	9.982914	9.456542	10.543458	2
59	9.439897	9.982878	9.457019	10.542980	1
60	9.440338	9.982842	9.457496	10.542503	0
	Co-fine	Sine	Co-tang	Tangent	M

F 2

Degree 16.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.40338	9.982842	9.457496	10.542503	60
1	9.440778	9.982805	9.457973	10.542027	59
2	9.441218	9.982769	9.458449	10.541551	58
3	9.441658	9.982733	9.458925	10.541075	57
4	9.442096	9.982695	9.459400	10.540600	56
5	9.442535	9.982660	9.459875	10.540125	55
6	9.442973	9.982623	9.460349	10.539651	54
7	9.443416	9.982587	9.460823	10.539177	53
8	9.443848	9.982550	9.461297	10.538703	52
9	9.444284	9.982514	9.461770	10.538230	51
10	9.444720	9.982477	9.462242	10.537758	50
11	9.445155	9.982441	9.462714	10.537285	49
12	9.445590	9.982404	9.463186	1.536814	48
13	9.446025	9.982367	9.463658	10.536341	47
14	9.446459	9.98230	9.464129	10.535871	46
15	9.446893	9.982294	9.464599	10.535401	45
16	9.447326	9.982257	9.465069	10.534931	44
17	9.447759	9.982220	9.465539	10.534461	43
18	9.448191	9.982183	9.466008	10.533992	42
19	9.448523	9.982146	6.466476	10.533523	41
20	9.449055	9.982109	9.466945	10.533055	40
21	9.449485	9.982072	9.467413	10.532587	39
22	9.449915	9.982035	9.467880	10.532120	38
23	9.450345	9.981998	9.468347	10.531653	37
24	9.450775	9.981961	9.468814	10.531186	36
25	9.451203	9.98192	9.469280	10.530720	35
26	9.451632	9.981886	9.469746	10.530254	34
27	9.452060	9.981849	9.470211	10.529789	33
28	9.452488	9.981812	9.470676	10.529324	32
29	9.452915	9.98174	9.471141	10.528859	31
30	9.453342	9.981737	9.471605	10.528395	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 73.

Degree 16.

M	Sine	Co-sin.	Tangent	Co-tang.	
30	9.453342	9.981737	9.471605	10.528395	30
31	9.453768	9.981699	9.472008	10.527991	29
32	9.454194	9.981662	9.472532	10.527458	28
33	9.454619	9.981624	9.472995	10.527005	27
34	9.455044	9.981587	9.473457	10.526543	26
35	9.455469	9.981549	9.473919	10.526081	25
36	9.455892	9.981512	9.474381	10.525619	24
37	9.456316	9.981474	9.474842	10.525158	23
38	9.456739	9.981436	9.475303	10.524697	22
39	9.457162	9.981398	9.475763	10.524237	21
40	9.457584	9.981361	9.476223	10.523777	20
41	9.458006	9.981323	9.476683	10.523317	19
42	9.458429	9.981285	9.477142	10.522858	18
43	9.458848	9.981247	9.477601	10.522399	17
44	9.459268	9.981209	9.478059	10.521941	16
45	9.459684	9.981171	9.478517	10.521483	15
46	9.460108	9.981133	9.478975	10.521025	14
47	9.460527	9.981095	9.479432	10.520568	13
48	9.460949	9.981057	9.479889	10.520111	12
49	9.461364	9.981019	9.480345	10.519655	11
50	9.461782	9.980980	9.480801	10.519199	10
51	9.462199	9.980942	9.481257	10.518743	9
52	9.462616	9.980904	9.481712	10.518288	8
53	9.463032	9.980866	9.482167	10.517833	7
54	9.463448	9.980827	9.482621	10.517379	6
55	9.463864	9.980789	9.483075	10.516925	5
56	9.464179	9.980750	9.483528	10.516471	4
57	9.464694	9.980712	9.483982	10.516018	3
58	9.465108	9.980672	9.484434	10.515566	2
59	9.465522	9.980635	9.484887	10.515113	1
60	9.465953	9.980596	9.485339	10.514661	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 73.

F 3

Degree 17.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.465935	9.980596	9.485339	10.514661	60
1	9.466348	9.980558	9.485791	10.514209	59
2	9.466761	9.980519	9.486242	10.513758	58
3	9.467173	9.980480	9.486693	10.513307	57
4	9.467585	9.980441	9.487143	10.512857	56
5	9.467996	9.980403	9.487593	10.512407	55
6	9.468407	9.980364	9.488043	10.511957	54
7	9.468817	9.980325	9.488493	10.511507	53
8	9.469227	9.980286	9.488941	10.511059	52
9	9.469637	9.980247	9.489390	10.510610	51
10	9.460446	9.980208	9.489838	10.510162	50
11	9.470455	9.980169	9.490286	10.509714	49
12	9.471863	9.980130	9.490733	10.509267	48
13	9.471071	9.980091	9.491180	10.508820	47
14	9.471678	9.980052	9.491627	10.508373	46
15	9.472086	9.980012	9.492073	10.507928	45
16	9.472492	9.979973	9.492519	10.507481	44
17	9.472898	9.979934	9.492964	10.507035	43
18	9.473404	9.979894	9.493410	10.506590	42
19	9.473710	9.979855	9.493854	10.506145	41
20	9.474115	9.979816	9.494299	10.505701	40
21	9.474519	9.979776	9.494743	10.505257	39
22	9.474923	9.979737	9.495186	10.504813	38
23	9.475327	9.979697	9.495630	10.504370	37
24	9.475730	9.979658	9.496073	10.503928	36
25	9.476133	9.979618	9.496515	10.503485	35
26	9.476536	9.979578	9.496957	10.503043	34
27	9.476938	9.979539	9.497399	10.502601	33
28	9.477340	9.979499	9.497840	10.502160	32
29	9.477741	9.979459	9.498282	10.501718	31
30	9.478142	9.979419	9.498722	10.501178	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 72.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.478142	9.979419	9.498722	10.501278	30
	9.478542	9.979380	9.499163	10.500837	29
	9.478942	9.979340	9.499602	10.500398	28
33	9.479342	9.979300	9.500042	10.499958	27
34	9.479741	9.979260	9.500481	10.499519	26
35	9.480141	9.979220	9.500920	10.499080	25
36	9.480538	9.979180	9.501359	10.498641	24
	9.480936	9.979140	9.501797	10.498203	23
	9.481334	9.979099	9.502234	10.497765	22
	9.481731	9.979059	9.502672	10.497328	21
40	9.482128	9.979019	9.503109	10.496891	20
41	9.482525	9.978980	9.503546	10.496454	19
42	9.482921	9.978939	9.503982	10.496018	18
43	9.483316	9.978898	9.504418	10.495582	17
44	9.483711	9.978858	9.504854	10.495146	16
45	9.484106	9.978817	9.505289	10.494711	15
46	9.484501	9.978777	9.505724	10.494276	14
47	9.484895	9.978736	9.506158	10.493842	13
48	9.485289	9.978696	9.506593	10.493407	12
49	9.485682	9.978656	9.507026	10.492973	11
50	9.486075	9.978615	9.507459	10.492540	10
51	9.486467	9.978574	9.507892	10.492107	9
	9.486859	9.978533	9.508326	10.491674	8
	9.487251	9.978493	9.508759	10.491241	7
54	9.487643	9.978452	9.509181	10.490809	6
	9.488033	9.978411	9.509622	10.490377	5
56	9.488424	9.978370	9.510044	10.489946	4
57	9.488814	9.978329	9.510485	10.489515	3
58	9.489204	9.978288	9.510915	10.489084	2
59	9.489593	9.978247	9.511346	10.488654	1
60	9.489982	9.978205	9.511776	10.488225	0
	Co-sine	Sine	Co-tang.	Tangent	M

E 4

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.489982	9.978226	9.511776	10.488224	60
1	9.490371	9.978165	9.512206	10.487794	59
2	9.490759	9.978124	9.512635	10.487365	58
3	9.491147	9.978083	9.513064	10.486936	57
4	9.491534	9.978042	9.513493	10.486507	56
5	9.491922	9.978000	9.513921	10.486079	55
6	9.492308	9.977955	9.514349	10.485651	54
7	9.492695	9.977918	9.514777	10.485223	53
8	9.493080	9.977877	9.515204	10.484796	52
9	9.493466	9.977835	9.515631	10.484369	51
10	9.493851	9.977794	9.516057	10.483942	50
11	9.494236	9.977752	9.516484	10.483516	49
12	9.494620	9.977711	9.516910	10.483090	48
13	9.495005	9.977669	9.517335	10.482665	47
14	9.495388	9.977628	9.517761	10.482239	46
15	9.495771	9.977586	9.518185	10.481814	45
16	9.496154	9.977544	9.518610	10.481390	44
17	9.496537	9.977503	9.519034	10.480966	43
18	9.496919	9.977461	9.519458	10.480542	42
19	9.497301	9.977419	9.519882	10.480118	41
20	9.497682	9.977377	9.520305	10.489695	40
21	9.498063	9.977335	9.520728	10.479272	39
22	9.498444	9.977293	9.521151	10.478842	38
23	9.498814	9.977251	9.521573	10.478427	37
24	9.499204	9.977209	9.521995	10.478005	36
25	9.499584	9.977167	9.522417	10.477583	35
26	9.499963	9.977125	9.522838	10.477162	34
27	9.500342	9.977083	9.523259	10.476741	33
28	9.500720	9.977041	9.523679	10.476320	32
29	9.501099	9.977999	9.524109	10.475900	31
30	9.501476	9.977956	9.524520	10.475480	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.501476	9.977956	9.524520	10.475480	30
31	9.501854	9.976914	9.524939	10.475060	29
32	9.502231	9.976872	9.525359	10.474641	28
33	9.502607	9.976830	9.525778	10.474222	27
34	9.502984	9.976787	9.526197	10.473803	26
35	9.503360	9.976745	9.526615	12.473385	25
36	9.503735	9.976702	9.527033	10.47.967	24
37	9.504110	9.976660	9.527451	10.472569	23
38	9.504485	9.976617	9.527868	10.472132	22
39	9.504840	9.975574	9.528285	10.471715	21
40	9.505234	9.976532	9.528702	10.471298	20
41	9.505608	9.976489	9.529118	10.470881	19
42	9.505981	9.976446	9.529535	10.470465	18
43	9.506354	9.976404	9.529950	10.470.49	17
44	9.506727	9.976361	9.530366	10.469634	16
45	9.507009	9.976318	9.530781	1.469219	15
46	9.507471	9.976275	9.531196	10.468804	14
47	9.507843	9.976232	9.531611	10.468389	13
48	9.508214	9.976185	9.532025	10.467975	12
49	9.508585	9.976146	9.532436	10.467561	11
50	9.508955	9.976103	9.532852	10.467147	10
51	9.509326	9.976060	9.533266	10.466734	9
52	9.509696	9.976017	9.533679	10.466321	8
53	9.510065	9.975973	9.534092	10.465908	7
54	9.510434	9.975930	9.534504	10.465496	6
55	9.510803	9.975887	9.534916	10.465084	5
56	9.511171	9.975844	9.535328	10.464672	4
57	9.511540	9.975800	9.535739	10.464261	3
58	9.511907	9.975757	9.536150	10.463849	2
59	9.512275	9.975713	9.536561	10.463439	1
60	9.512642	9.975670	9.536972	10.463028	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.512642	9.975670	9.536972	10.463028	60
1	9.513009	9.975626	9.537382	10.462618	59
2	9.513375	9.975583	9.537792	10.462208	58
3	9.513741	9.975539	9.538202	10.461798	57
4	9.514107	9.975496	9.538610	10.461389	56
5	9.514472	9.975452	9.539020	10.460980	55
6	9.514837	9.975408	9.539429	10.460571	54
7	9.515202	9.975364	9.539837	10.460163	53
8	9.515566	9.975321	9.540245	10.459755	52
9	9.515930	9.975277	9.540653	10.459347	51
10	9.516294	9.975233	9.541061	10.458939	50
11	9.516657	9.975189	9.541468	10.458532	49
12	9.517020	9.975145	9.541875	10.458125	48
13	9.517382	9.975101	9.542281	10.457719	47
14	9.517745	9.975057	9.542688	10.457312	46
15	9.518107	9.975013	9.543094	10.456906	45
16	9.518468	9.874969	9.543499	10.456501	44
17	9.518829	9.974925	9.543905	10.456095	43
18	9.519190	9.974880	9.544310	10.455690	42
19	9.519551	9.974836	9.544715	10.455285	41
20	9.519911	9.974792	9.545119	10.454881	40
21	9.520271	9.974747	9.545524	10.454476	39
22	9.520631	9.974703	9.545927	10.454072	38
23	9.520990	9.974659	9.546331	10.453669	37
24	9.521349	9.974614	9.546735	10.453265	36
25	9.521707	9.974570	9.547138	10.452862	35
26	9.522065	9.974525	9.547540	10.452459	34
27	9.522423	9.974480	9.547943	10.452057	33
28	9.522781	9.974436	9.548345	10.451655	32
29	9.523138	9.974391	9.548747	10.451253	31
30	9.523495	9.974346	9.549149	10.450851	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
	9.523495	9.974346	9.549149	10.450851	30
	9.523851	9.974302	9.549550	10.450450	29
	9.524208	9.974257	9.549951	10.450049	28
	9.524564	9.974212	9.550352	10.449648	27
	9.524920	9.974167	9.550752	10.449248	26
	9.525275	9.974122	9.551152	10.448848	25
	9.525630	9.974077	9.551552	10.448448	24
	9.525984	9.974031	9.551952	10.448048	23
	9.526339	9.973987	9.552351	10.447649	22
	9.526693	9.973941	9.552750	10.447250	21
	9.527046	9.973897	9.553149	10.446851	20
	9.527400	9.973852	9.553548	10.446452	19
	9.527753	9.973807	9.553945	10.446054	18
	9.528105	9.973761	9.554344	10.445656	17
	9.528458	9.973716	9.554741	10.445259	16
	9.528810	9.973671	9.555139	10.444861	15
	9.529161	9.973625	9.555536	10.444464	14
	9.529513	9.973580	9.555932	10.444068	13
	9.529864	9.973535	9.556329	10.443671	12
	9.530214	9.973489	9.556725	10.443275	11
	9.530565	9.973443	9.557121	10.442879	10
	9.530915	9.973398	9.557517	10.442483	9
	9.531265	9.973352	9.557912	10.442088	8
	9.531614	9.973307	9.558308	10.441693	7
	9.531964	9.973261	9.558702	10.441298	6
	9.532312	9.973215	9.559097	10.440903	5
	9.532661	9.973169	9.559491	10.440509	4
	9.533009	9.973123	9.559885	10.440115	3
	9.533357	9.973078	9.560279	10.439721	2
	9.533704	9.973032	9.560673	10.439327	1
	9.534052	9.972986	9.561066	10.438934	0

	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.534052	9.97 986	9.561066	10.438934	60
1	9.534399	9.972940	9.561459	10.438541	59
2	9.534746	9.972894	9.561851	10.438148	58
3	9.535091	9.972848	9.562236	10.437756	57
4	9.535437	9.972801	9.561636	10.437364	56
5	9.535782	9.972755	9.563028	10.436972	55
6	9.536129	9.972709	9.563419	10.436580	54
7	9.536474	9.972663	9.563811	10.436189	53
8	9.536818	9.972617	9.564202	10.435798	52
9	9.537163	9.972570	9.564592	10.435407	51
10	9.537507	9.972524	9.564983	10.435017	50
11	9.537851	9.972477	9.565373	10.434627	49
12	9.538194	9.972431	9.565763	10.434237	48
13	9.538537	9.972384	9.566153	10.433847	47
14	9.538880	9.972338	9.566542	10.433457	46
15	9.539222	9.972291	9.566932	10.433068	45
16	9.539560	9.972245	9.567320	10.432679	44
17	9.539907	9.972198	9.567709	10.432291	43
18	9.540249	9.972151	9.568097	10.431902	42
19	9.540590	9.972105	9.568486	10.431514	41
20	9.540931	9.972058	9.568873	10.431126	40
21	9.541272	9.972011	9.569261	10.430739	39
22	9.541612	9.971964	9.569648	10.430351	38
23	9.541953	4.971917	9.560035	10.429964	37
24	9.542292	9.971870	9.5604.2	10.429578	36
25	9.542632	9.971823	9.560809	10.429191	35
26	9.542971	9.971776	9.571195	10.428805	34
27	9.543310	9.971729	9.571581	10.428419	33
28	9.543649	9.971682	9.571967	10.428033	32
29	9.543987	9.971635	9.572352	10.427648	31
30	9.544325	9.971588	9.572738	10.427262	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.544325	9.971588	9.572738	10.427262	30
31	9.544663	9.971540	9.573123	10.426877	29
32	9.545000	9.971492	9.573507	10.426492	28
33	9.545338	9.971446	9.573892	10.426108	27
34	9.545674	9.971398	9.574276	10.425724	26
35	9.546011	9.971351	9.574560	10.425340	25
36	9.546347	9.971303	9.575044	10.424956	24
37	9.546683	9.971256	9.575427	10.424573	23
38	9.547019	9.971208	9.575810	10.424189	22
39	9.547354	9.971161	9.576193	10.423807	21
40	9.547689	9.971112	9.576576	10.423424	20
41	9.548024	9.971065	9.576958	10.423041	19
42	9.548358	9.971018	9.577341	10.422659	18
43	9.548693	9.970970	9.577723	10.422277	17
44	9.549026	9.970922	9.578104	10.421896	16
45	9.549360	9.970874	9.578486	10.421514	15
46	9.549693	9.970826	9.578867	10.421133	14
47	9.550026	9.970779	9.579248	10.420752	13
48	9.550359	9.970731	9.579628	10.420371	12
49	9.550692	9.970683	9.580009	10.419991	11
50	9.551024	9.970634	9.580389	10.419611	10
51	9.551355	9.970586	9.580769	10.419231	9
52	9.551687	9.970538	9.581149	10.418851	8
53	9.552018	9.970490	9.581528	10.418472	7
54	9.552349	9.970442	9.581907	10.418092	6
55	9.552680	9.970394	9.582286	10.417713	5
56	9.553010	9.970345	9.582665	10.417335	4
57	9.553340	9.970297	9.583043	10.416956	3
58	9.553670	9.970249	9.583422	10.416578	2
59	9.554000	9.970200	9.583800	10.416200	1
60	9.554329	9.970152	9.584177	10.415823	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.554329	9.970152	9.584177	10.415822	60
1	9.554618	9.970105	9.584555	10.415445	59
2	9.554907	9.970055	9.584932	10.415068	58
3	9.555215	9.970006	9.585308	10.414691	57
4	9.555643	9.969957	9.585686	10.414314	56
5	9.555971	9.969909	9.586062	10.413938	55
6	9.556299	9.969860	9.586439	10.413561	54
7	9.555626	9.969811	9.586815	10.413185	53
8	9.556953	9.969762	9.587190	10.412809	52
9	9.557279	9.969713	9.587566	10.412434	51
10	9.557606	9.969665	9.587941	10.412059	50
11	9.557932	9.969616	9.588316	10.411684	49
12	9.558258	9.969567	9.588691	10.411309	48
13	9.558583	9.969518	9.589066	10.410934	47
14	9.558909	9.969469	9.589440	10.410560	46
15	9.559234	9.969419	9.589814	10.410185	45
16	9.559558	9.969370	9.590188	10.409812	44
17	9.559883	9.969321	9.590561	10.409438	43
18	9.560207	9.969272	9.590935	10.409065	42
19	9.560531	9.969223	9.591308	10.408692	41
20	9.560855	9.969173	9.591681	10.408319	40
21	9.561178	9.969124	9.592054	10.407945	39
22	9.561501	9.969075	9.592426	10.407574	38
23	9.561824	9.969025	9.592798	10.407221	37
24	9.562146	9.968976	9.593170	10.406829	36
25	9.562468	9.968926	9.593542	10.406457	35
26	9.562790	9.968877	9.593914	10.406086	34
27	9.563112	9.968827	9.594285	10.405715	33
28	9.563433	9.968777	9.594656	10.405344	32
29	9.563754	9.968728	9.595027	10.405073	31
30	9.564275	.968678	9.595397	10.404602	30
	Co-fine	Sine	Co-tang.	Tangent	M

Degree 21.

M	Sine	Co-sine	Tangent	Co-Tang.	
30	9.564075	9.968678	9.595397	10.404602	30
31	9.564395	9.968628	9.595768	10.404232	29
32	9.564718	9.968578	9.596138	10.403861	28
33	9.565036	9.968528	9.596508	10.403492	27
34	9.565356	9.968478	9.596878	10.403122	26
35	9.565675	9.968428	9.597247	10.402753	25
36	9.565995	9.968378	9.597616	10.402384	24
37	9.566314	9.968328	9.597985	10.402015	23
38	9.566631	9.968278	9.598354	10.401646	22
39	9.566951	9.968228	9.598712	10.401277	21
40	9.567269	9.968178	9.599091	10.400909	20
41	9.567587	9.968128	9.599459	10.400541	19
42	9.567904	9.968078	9.599827	10.400173	18
43	9.568222	9.968027	9.600194	10.399806	17
44	9.568539	9.967977	9.600561	10.399438	16
45	9.568855	9.967927	9.600929	10.399071	15
46	9.569172	9.967876	9.601296	10.398704	14
47	9.569488	9.967826	9.601662	10.398337	13
48	9.569804	9.967775	9.602029	10.397971	12
49	9.570120	9.967725	9.602395	10.397605	11
50	9.570435	9.967674	9.602761	10.397239	10
51	9.570751	9.967623	9.603127	10.396873	9
52	9.571065	9.967573	9.603493	10.396507	8
53	9.571380	9.967522	9.603858	10.396142	7
54	9.571695	9.967471	9.604223	10.395777	6
55	9.572009	9.967420	9.604588	10.395412	5
56	9.572323	9.967370	9.604953	10.395047	4
57	9.572636	9.967319	9.605317	10.394683	3
58	9.572949	9.967268	9.605681	10.394318	2
59	9.573263	9.967217	9.606046	10.393954	1
60	9.573575	9.967166	9.606409	10.393592	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 68.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.573575	9.967166	9.606409	10.393590	60
1	9.573888	9.967115	9.606773	10.393227	59
2	9.574200	9.967064	9.607136	10.392864	58
3	9.574512	9.967012	9.607500	10.392500	57
4	9.574824	9.966961	9.607862	10.392137	56
5	9.575135	9.966910	9.608225	10.391774	55
6	9.575447	9.966859	9.608588	10.391412	54
7	9.575758	9.966807	9.608950	10.391050	53
8	9.576068	9.966756	9.609312	10.390688	52
9	9.576379	9.966705	9.609674	10.390326	51
10	9.576689	9.966653	9.610036	10.399964	50
11	9.576999	9.966602	9.610397	10.389603	49
12	9.577309	9.966550	9.610758	10.389241	48
13	9.577618	9.966499	9.611119	10.388880	47
14	9.577927	9.966447	9.611480	10.388520	46
15	9.578236	9.966395	9.611841	10.388159	45
16	9.578545	9.966344	9.612201	10.387799	44
17	9.578853	9.966292	9.612561	10.387438	43
18	9.579161	9.966240	9.612921	10.387078	42
19	9.579469	9.966188	9.613281	10.386719	41
20	9.579777	9.966136	9.613641	10.386359	40
21	9.580084	9.966084	9.614000	10.386000	39
22	9.580392	9.966032	9.614359	10.385641	38
23	9.580698	9.965980	9.614718	10.385282	37
24	9.581005	9.965928	9.615077	10.384923	36
25	9.581311	9.965876	9.615435	10.384565	35
26	9.581618	9.965824	9.615793	10.384207	34
27	9.581923	9.965772	9.616151	10.383448	33
28	9.582229	9.965720	9.616509	10.383491	32
29	9.582534	9.965668	9.616867	10.383133	31
30	9.582840	9.965615	9.617224	10.382776	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.582840	9.965615	9.617224	10.382776	30
31	9.583144	9.965563	9.617581	10.382418	29
32	9.583449	9.965511	9.617938	10.382061	28
33	9.583752	9.965458	9.618295	10.381705	27
34	9.584058	9.965406	9.618651	10.381348	26
35	9.584361	9.965353	9.619008	10.380992	25
36	9.584665	9.965301	9.619364	10.380635	24
37	9.584968	9.965248	9.619722	10.380279	23
38	9.585271	9.965195	9.620076	10.399924	22
39	9.585574	9.965143	9.620432	10.379568	21
40	9.585877	9.965090	9.620787	10.379213	20
41	9.586179	9.965037	9.621142	10.378858	19
42	9.586481	9.964984	9.621497	10.378502	17
43	9.586783	9.964931	9.621852	10.378148	16
44	9.587085	9.964878	9.622206	10.377793	15
45	9.587386	9.964825	9.622561	10.377439	14
46	9.587687	9.964772	9.622915	10.377085	13
47	9.587988	9.964719	9.623269	10.376731	12
48	9.588289	9.964666	9.623623	10.976377	11
49	9.588589	9.964613	9.623976	10.376024	10
50	9.588890	9.964560	9.624330	10.375670	9
51	9.589190	9.964507	9.624683	10.375317	8
52	9.589489	9.964154	9.625036	10.374964	7
53	9.589789	9.964400	9.625388	10.374611	6
54	9.590088	9.964347	9.625741	10.374259	5
55	9.590387	9.964294	9.626093	10.373907	4
56	9.590686	9.964240	9.626445	10.373555	3
57	9.590984	9.964187	9.626797	10.373203	2
58	9.591282	9.964133	9.627149	10.372850	1
59	9.591580	9.964080	9.627501	10.372499	0
60	9.591878	9.964026	9.627852	10.372148	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.591878	9.964026	9.627852	10.372148	60
1	9.592175	9.963971	9.628203	10.373797	59
2	9.592473	9.963919	9.628554	10.371446	58
3	9.592770	9.963865	9.628905	10.371095	57
4	9.593067	9.963811	9.629255	10.370744	56
5	9.593363	9.963757	9.629606	10.370394	55
6	9.593659	9.963703	9.629956	10.370044	54
7	9.593955	9.963650	9.630306	10.369694	53
8	9.594251	9.963596	9.630655	10.369344	52
9	9.594547	9.963542	9.631005	10.368995	51
10	9.594842	9.963488	9.631354	10.368645	50
11	9.595137	9.963434	9.631704	10.368296	49
12	9.595432	9.963379	9.632053	10.367947	48
13	9.595727	9.963325	9.632401	10.367598	47
14	9.596021	9.963271	9.632750	10.367250	46
15	9.596315	9.963217	9.633098	10.366901	45
16	9.596610	9.963102	9.633447	10.366553	44
17	9.596903	9.963108	9.633795	10.366205	43
18	9.597196	9.963053	9.634143	10.365817	42
19	9.597490	9.962999	9.634490	10.365510	41
20	9.597783	9.962945	9.634838	10.365162	40
21	9.598075	9.962892	9.635185	10.364815	39
22	9.598368	9.962836	9.635530	10.364468	38
23	9.598660	9.962781	9.635879	10.364121	37
24	9.598952	9.962726	9.636226	10.363774	36
25	9.599244	9.962672	9.636572	10.363428	35
26	9.599536	9.962617	9.636918	10.363081	34
27	9.599827	9.962562	9.637205	10.362735	33
28	9.600118	9.962507	9.637610	10.362389	32
29	9.600409	9.962453	9.637956	10.362044	31
30	9.600700	9.962398	9.638302	10.361698	30
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
30	9.600700	9.962298	3.638302	10.361698	30
31	9.600990	9.962243	9.638647	10.361353	29
32	9.601280	9.962288	9.638992	10.361007	28
33	9.601570	9.962233	9.639337	10.360662	27
34	9.601860	9.962178	9.639682	10.360318	26
35	9.602149	9.962122	9.640027	10.359973	25
36	9.602439	9.962067	9.640471	10.359629	24
37	9.602728	9.962012	9.640716	10.359284	23
38	9.603017	9.961957	9.641060	10.358640	22
39	9.603305	9.961902	9.641404	10.358596	21
40	9.603594	9.961846	9.641747	10.358253	20
41	9.603882	9.961791	9.642091	10.357909	19
42	9.604170	9.961735	9.642434	10.357566	17
43	9.604457	9.961680	9.642777	10.357223	16
44	9.604745	9.961624	9.643120	10.356980	15
45	9.605032	9.961569	9.643463	10.356537	14
46	9.605319	9.961513	9.643806	10.356194	13
47	9.605606	9.961458	9.644148	10.355852	12
48	9.605892	9.961402	9.644490	10.355510	11
49	9.606179	9.961346	9.644832	10.355168	10
50	9.606465	9.961290	9.645174	10.354826	9
51	9.606750	9.961235	9.645516	10.354484	8
52	9.607039	9.961179	9.645857	10.354142	7
53	9.607322	9.961123	9.646199	10.353801	6
54	9.607607	9.961067	9.646540	10.353460	5
55	9.607892	9.961011	9.646881	10.353119	4
56	9.608176	9.960955	9.647222	10.352778	3
57	9.608461	9.960899	9.647561	10.352438	2
58	9.608745	9.960842	9.647903	10.352097	1
59	9.609029	9.960786	9.648243	10.351757	0
60	9.609313	9.960730	9.648583	10.351417	
	Co-fine	Sien	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.609313	9.960730	9.648583	10.351417	60
1	9.609597	9.960674	9.648923	10.351077	59
2	9.609880	9.960617	9.649263	10.350737	58
3	9.610163	9.960561	9.649602	10.350318	57
4	9.610446	9.960505	9.649941	10.350058	56
5	9.610729	9.960448	9.650281	10.349719	55
6	9.611012	9.960392	9.650620	10.349380	54
7	9.611294	9.960335	9.650959	10.349041	53
8	9.611576	9.960279	9.651297	10.348703	52
9	9.611858	9.960222	9.651636	10.348364	51
10	9.612140	9.960165	9.651974	10.348026	50
11	9.612421	9.960109	9.652312	10.347688	49
12	9.612702	9.960052	9.652650	10.347350	48
13	9.612983	9.959995	9.652988	10.347012	47
14	9.613264	9.959938	9.653326	10.346674	46
15	9.613545	9.959881	9.653663	10.346337	45
16	9.614825	9.959824	9.654000	10.345999	44
17	9.614105	9.959768	9.654337	10.345662	43
18	9.614385	9.959710	9.654674	10.345325	42
19	9.614665	9.959653	9.655011	10.344989	41
20	9.614944	9.959596	9.655348	10.344652	40
21	9.615223	9.959539	9.655684	10.344316	39
22	9.615502	9.959482	9.656010	10.343980	38
23	9.615781	9.959425	9.656356	10.343644	37
24	9.616050	9.959367	9.656691	10.343308	36
25	9.616338	9.959310	9.657028	10.342972	35
26	9.616616	9.959253	9.657363	10.342636	34
27	9.616894	9.959195	9.657699	10.342301	33
28	9.617172	9.959138	9.658034	10.341966	32
29	9.617450	9.959080	9.658369	10.341631	31
30	9.617727	9.959023	9.658704	10.341296	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.617727	9.959023	9.658704	10.341296	30
31	9.618004	9.958965	9.659039	10.340926	29
32	9.618281	9.958908	9.659373	10.340627	28
33	9.618558	9.958850	9.659708	10.340292	27
34	9.618834	9.958792	9.660042	10.239958	26
35	9.619110	9.958734	9.660376	10.239624	25
36	9.619386	9.958677	9.660710	10.339290	24
37	9.619662	9.958619	9.661043	10.338957	23
38	9.619938	9.958561	9.661377	10.338623	22
39	9.620213	9.958503	9.661710	10.338290	21
40	9.620488	9.958445	9.662043	10.337956	20
41	9.620763	9.958387	9.662376	10.337623	19
42	9.621038	9.958329	9.662709	10.337291	18
43	9.621313	9.958271	9.663042	10.336958	17
44	9.621587	9.958212	9.663374	10.336625	16
45	9.621861	9.958154	9.663707	10.336293	15
46	9.622135	9.958096	9.664039	10.335961	14
47	9.622409	9.958038	9.664371	10.335629	13
48	9.622682	9.957979	9.664703	10.335297	12
49	9.622956	9.957921	9.665035	10.334965	11
50	9.623229	9.957862	9.665366	10.334634	10
51	9.623502	9.957804	9.665697	10.334302	9
52	9.623776	9.957745	9.666029	10.333971	8
53	9.624047	9.957687	9.666360	10.333640	7
54	9.624319	9.957628	9.666691	10.333309	6
55	9.624591	9.957570	9.667021	10.332979	5
56	9.624863	9.957511	9.667352	10.332648	4
57	9.625134	9.957452	9.667682	10.332318	3
58	9.625406	9.957393	9.668012	10.331987	2
59	9.625677	9.957334	9.668343	10.331657	1
60	9.625948	9.957276	9.668673	10.331327	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.625948	9.957276	9.618672	10.331327	60
1	9.626219	9.957217	9.669002	10.330998	59
2	9.626490	9.957158	9.669332	10.330668	58
3	9.626760	9.957099	9.669661	10.330339	57
4	9.627030	9.957040	9.669990	10.330009	56
5	9.627300	9.956981	9.670320	10.329680	55
6	9.627570	9.956922	9.670649	10.329351	54
7	9.627840	9.956862	9.670977	10.329022	53
8	9.628109	9.956803	9.671305	10.328694	52
9	9.628378	9.956744	9.671634	10.328365	51
10	9.628647	9.956684	9.671963	10.328037	50
11	9.628916	9.956625	9.672291	10.327709	49
12	9.629184	9.956565	9.672619	10.327381	48
13	9.629453	9.956506	9.672947	10.327053	47
14	9.629721	9.956446	9.673274	10.326725	46
15	9.629989	9.956387	9.673603	10.326398	45
16	9.630257	9.956327	9.673929	10.326070	44
17	9.630524	9.956267	9.674256	10.325743	43
18	9.630792	9.956208	9.674584	10.325416	42
19	9.631059	9.956148	9.674910	10.325089	41
20	9.631326	9.956088	9.675237	10.324763	40
21	9.631592	9.956029	9.675564	10.324436	39
22	9.631859	9.955969	9.675890	10.324110	38
23	9.632125	9.955909	9.676216	10.323783	37
24	9.632391	9.955849	9.676543	10.323457	36
25	9.632657	9.955789	9.676869	10.323131	35
26	9.632923	9.955789	9.677194	10.322805	34
27	9.633189	9.955669	9.677520	10.322480	33
28	9.633454	9.955609	9.677845	10.322154	32
29	9.633719	9.955548	9.678171	10.321829	31
30	9.633984	9.955488	9.678496	10.321504	30
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.633984	9.955488	9.678496	10.321504	30
31	9.634249	9.955428	9.678821	10.321179	29
32	9.634514	9.955367	9.679146	10.320854	28
33	9.634778	9.955307	9.679471	10.320529	27
34	9.635042	9.955246	9.679795	10.320205	26
35	9.635306	9.955186	9.680120	10.319880	25
36	9.635570	9.955125	9.680444	10.319556	24
37	9.635833	9.955065	9.680768	10.319232	23
38	9.636097	9.955004	9.681092	10.318908	22
39	9.636360	9.954944	9.681416	10.318584	21
40	9.636623	9.954883	9.681740	10.318260	20
41	9.636886	9.954823	9.682063	10.317937	19
42	9.637148	9.954762	9.682386	10.317613	18
43	9.637411	9.954701	9.682710	10.317290	17
44	9.637673	9.954640	9.683033	10.316967	16
45	9.637935	9.954579	9.683356	10.316644	15
46	9.638197	9.954518	9.683678	10.316321	14
47	9.638458	9.954457	9.684001	10.315999	13
48	9.638720	9.954396	9.684324	10.315676	12
49	9.638981	9.954335	9.684646	10.315354	11
50	9.639242	9.954274	9.684968	10.315032	10
51	9.639503	9.954213	9.685290	10.314710	9
52	9.639764	9.954152	9.685612	10.314388	8
53	9.640024	9.954090	9.685934	10.314066	7
54	9.640284	9.954029	9.686255	10.313745	6
55	9.640545	9.953968	9.686577	10.313423	5
56	9.640804	9.953906	9.686898	10.313102	4
57	9.641064	9.953845	9.687219	10.312781	3
58	9.641323	9.953783	9.687540	10.312460	2
59	9.641583	9.953722	9.687861	10.312138	1
60	9.641842	9.953660	9.688182	10.311818	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.641842	9.953660	9.688182	10.311818	60
1	9.642101	9.953598	9.688502	10.311498	59
2	9.642360	9.953537	9.688823	10.311177	58
3	9.642618	9.953475	9.689143	10.310857	57
4	9.642876	9.953413	9.689463	10.310537	56
5	9.643135	9.953351	9.689783	10.310217	55
6	9.643293	9.953290	9.690103	10.309897	54
7	9.643650	9.953228	9.690423	10.309577	53
8	9.643908	9.953166	9.690742	10.309258	52
9	9.644165	9.953104	9.691063	10.308938	51
10	9.644423	9.953042	9.691281	10.308619	50
11	9.644680	9.952980	9.691700	10.308300	49
12	9.644936	9.952917	9.692019	10.307981	48
13	9.645193	9.952855	9.692338	10.307662	47
14	9.645449	9.952793	9.692656	10.307343	46
15	9.645706	9.952731	9.692975	10.307025	45
16	9.645961	9.952668	9.693293	10.306706	44
17	9.646218	9.952606	9.693612	10.306388	43
18	9.646473	9.952544	9.693930	10.306070	42
19	9.646729	9.952481	9.694248	10.305752	41
20	9.646984	9.952419	9.694566	10.305434	40
21	9.647139	9.952356	9.694883	10.305117	39
22	9.647494	9.952294	9.695201	10.304799	38
23	9.647749	9.952231	9.695518	10.304482	37
24	9.648004	9.952168	9.695835	10.304164	36
25	9.648258	9.952105	9.696153	10.303847	35
26	9.648512	9.952043	9.696470	10.303530	34
27	9.648766	9.951980	9.696786	10.303213	33
28	9.648020	9.951917	9.697103	10.302897	32
29	9.649274	9.951853	9.697420	10.302580	31
30	9.649527	9.951791	9.697728	10.302264	30
	Co-sine	Sien	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.649527	9.951791	9.697738	10.302264	30
31	9.649781	9.951728	9.698052	10.301947	29
32	9.650034	9.951665	9.698369	10.301631	28
33	9.650287	9.951602	9.698685	10.301315	27
34	9.650539	9.951539	9.699001	10.300999	26
35	9.650798	9.951476	9.699316	10.300684	25
36	9.651044	9.951412	9.699632	10.300368	24
37	9.651296	9.951349	9.699947	10.300052	23
38	9.651648	9.951286	9.700263	10.299737	22
39	9.651800	9.951222	9.700578	10.299422	21
40	9.652052	9.951159	9.700893	10.299107	20
41	9.652303	9.951095	9.701208	10.298792	19
42	9.652555	9.951032	9.701522	10.298477	18
43	9.652806	9.950968	9.701837	10.298163	17
44	9.653057	9.950905	9.702152	10.297848	16
45	9.653307	9.950841	9.702466	10.297534	15
46	9.653558	9.950777	9.702780	10.297219	14
47	9.653808	9.950714	9.703095	10.296905	13
48	9.654059	9.950650	9.703409	10.296591	12
49	9.654309	9.950586	9.703722	10.296277	11
50	9.654558	9.950522	9.704036	10.295964	10
51	9.654808	9.950459	9.704350	10.295650	9
52	9.655057	9.950394	9.704663	10.295337	8
53	9.655307	9.950330	9.704976	10.295023	7
54	9.655556	9.950266	9.705290	10.294710	6
55	9.655805	9.950202	9.705623	10.294397	5
56	9.656053	9.950138	9.705915	10.294084	4
57	9.656302	9.950074	9.706228	10.293771	3
58	9.656550	9.950009	9.706541	10.293459	2
59	9.656799	9.949945	9.706853	10.293146	1
60	9.656347	9.949881	9.707166	10.292834	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co sine	Tangent	Co-ting.	
0	9.657047	9.949840	9.707166	10.292834	60
1	9.657293	9.949816	9.707478	10.292522	59
2	9.657542	9.949752	9.707790	10.292210	58
3	9.657790	9.949687	9.708102	10.291897	57
4	9.658039	9.949623	9.708414	10.291586	56
5	9.658286	9.949559	9.708726	10.291274	55
6	9.658531	9.949449	9.709037	10.290960	54
7	9.658777	9.949429	9.709349	10.290651	53
8	9.659024	9.949364	9.709660	10.290340	52
9	9.659271	9.949300	9.709971	10.290029	51
10	9.659517	9.949238	9.710282	10.289718	50
11	9.659762	9.949174	9.710593	10.289407	49
12	9.660009	9.949109	9.710904	10.289096	48
13	9.660255	9.949040	9.711214	10.288786	47
14	9.660500	9.948976	9.711525	10.288475	46
15	9.660746	9.948910	9.711836	10.288164	45
16	9.660991	9.948845	9.712146	10.287854	44
17	9.661236	9.948760	9.712456	10.287544	43
18	9.661481	9.948715	9.712766	10.287234	42
19	9.661726	9.948650	9.713076	10.286924	41
20	9.661970	9.948584	9.713385	10.286614	40
21	9.662214	9.948519	9.713695	10.286305	39
22	9.662459	9.948453	9.714005	10.285995	38
23	9.662703	9.948388	9.714314	10.285686	37
24	9.662947	9.948323	9.714624	10.285375	36
25	9.663192	9.948257	9.714933	10.285069	35
26	9.663433	9.948191	9.715242	10.284758	34
27	9.663677	9.948126	9.715550	10.284449	33
28	9.663920	9.948060	9.715859	10.284149	32
29	9.664164	9.947995	9.716168	10.283832	31
30	9.664406	9.947929	9.716477	10.283523	30
	Co sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.664406	9.947929	9.716477	10.283523	30
31	9.664648	9.947863	9.716785	10.283215	29
32	9.664891	9.947797	9.717093	10.282907	28
33	9.665133	9.947731	9.717401	10.282598	27
34	9.665375	9.947665	9.717709	10.282290	26
35	9.665617	9.947599	9.718017	10.281982	25
36	9.665858	9.947533	9.718325	10.281675	24
37	9.666100	9.947467	9.718633	10.281367	23
38	9.666341	9.947401	9.718940	10.281060	22
39	9.666583	9.947335	9.719248	10.280752	21
40	9.666824	9.947269	9.719555	10.280445	20
41	9.667065	9.947203	9.719862	10.280138	19
42	9.667305	9.947136	9.720169	10.279831	18
43	9.667546	9.947070	9.720476	10.279524	17
44	9.667786	9.947004	9.720783	10.279217	16
45	9.668026	9.946937	9.721089	10.278911	15
46	9.668266	9.946871	9.721395	10.278664	14
47	9.668506	9.946804	9.721702	10.278298	13
48	9.668746	9.946738	9.722008	10.277991	12
49	9.668986	9.946671	9.722315	10.277685	11
50	9.669225	9.946604	9.722621	10.277379	10
51	9.669464	9.946537	9.722927	10.277073	9
52	9.669703	9.946471	9.723232	10.276768	8
53	9.669942	9.946404	9.723538	10.276461	7
54	9.670181	9.946337	9.723843	10.276156	6
55	9.670419	9.946270	9.724149	10.275851	5
56	9.670657	9.946202	9.724454	10.275546	4
57	9.670896	9.946136	9.724759	10.275240	3
58	9.671134	9.946069	9.725065	10.274935	2
59	9.671372	9.946002	9.725369	10.274630	1
60	9.671609	9.945935	9.725674	10.274326	0

| | Co-sine | Sine | Co-tang. | Tangent | M |

G 2

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.671609	9.945935	9.725674	10.274326	60
1	9.671847	9.945868	9.725979	10.274011	59
2	9.672084	9.945800	9.726284	10.273816	58
3	9.672321	9.945733	9.726588	10.273412	57
4	9.672558	9.945666	9.726892	10.273197	56
5	9.672795	9.945558	9.727197	10.272803	55
6	9.673033	9.945531	9.727501	10.272499	54
7	9.673268	9.945463	9.727805	10.272195	53
8	9.673505	9.945396	9.728109	10.271891	52
9	9.673741	9.945328	9.728412	10.271587	51
10	9.673977	9.945261	9.728716	10.271284	50
11	9.674213	9.945193	9.729020	10.270980	49
12	9.674449	9.945125	9.729323	10.270677	48
13	9.674684	9.945058	9.729626	10.270374	47
14	9.674919	9.944990	9.729929	10.270070	46
15	9.675154	9.944922	9.730232	10.279767	45
16	9.675389	9.944854	9.730525	10.269464	44
17	9.675623	9.944786	9.730838	10.269162	43
18	9.675859	9.944718	9.731441	10.268859	42
19	9.676094	9.944650	9.731443	10.268556	41
20	9.676318	9.944582	9.731746	10.268254	40
21	9.676562	9.944514	9.732048	10.267952	39
22	9.676796	9.944446	9.732351	10.267649	38
23	9.677030	9.944377	9.732653	10.267347	37
24	9.677264	9.944309	9.732955	10.267045	36
25	9.677497	9.944241	9.733257	10.266743	35
26	9.677731	9.944172	9.733558	10.266441	34
27	9.677964	9.944104	9.733860	10.266140	33
28	9.678197	9.944016	9.734162	10.265838	32
29	9.678430	9.943967	9.73.463	10.265537	31
30	9.678663	9.943898	9.734764	10.265236	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 28.

Degree 61.

M.	Sine	Co-sine	Tangent	Co-tang.	
30	9.678663	9.943898	9.734764	10.265236	30
31	9.678895	9.943840	9.735666	10.264934	29
32	9.679128	9.943768	9.735362	10.264633	28
33	9.679360	9.943692	9.735668	10.264332	27
34	9.679592	9.943624	9.735968	10.264031	26
35	9.679824	9.943551	9.736269	10.263731	25
36	9.680056	9.943486	9.736570	10.263430	24
37	9.680288	9.943417	9.736870	10.263130	23
38	9.680519	9.943348	9.737171	10.262829	22
39	9.680750	9.943279	9.737471	10.262529	21
40	9.680982	9.943210	9.737771	10.262229	20
41	9.681213	9.943141	9.738071	10.261919	19
42	9.681443	9.943072	9.738371	10.261629	18
43	9.681674	9.943003	9.738671	10.261329	17
44	9.681904	9.942933	9.738971	10.261029	16
45	9.682135	9.942864	9.739271	10.260729	15
46	9.682365	9.942795	9.739570	10.260430	14
47	9.682595	9.942725	9.739870	10.260130	13
48	9.682825	9.942656	9.740169	10.259831	12
49	9.683055	9.942587	9.740468	10.259532	11
50	9.683284	9.642517	9.740767	10.259233	10
51	9.683514	9.942448	9.741066	10.258934	9
52	9.683743	9.942378	9.741365	10.258635	8
53	9.683972	9.942308	9.741664	10.258336	7
54	9.684201	9.942239	9.741962	10.258038	6
55	9.684430	9.942169	9.742261	10.257739	5
56	9.684658	9.942099	9.742559	10.257441	4
57	9.684887	9.942029	9.742858	10.257142	3
58	9.685115	9.941959	9.743156	10.256844	2
59	9.685343	9.941889	9.743454	10.256546	1
60	9.685571	9.941819	9.743751	10.256248	0
	Co-sine	Sine	Co-tang.	Tangent	M.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.685571	9.941819	9.743752	10.256248	60
1	9.685799	9.941749	9.744050	10.255950	59
2	9.686027	9.941679	9.744348	10.255652	58
3	9.686254	9.941609	9.744645	1.255355	57
4	9.686482	9.941539	9.744943	10.255057	56
5	9.686709	9.941468	9.745240	10.254760	55
6	9.686936	9.941398	9.745538	1c.254462	54
7	9.687163	9.941328	9.745835	10.254165	53
8	9.687389	9.941257	9.746132	10.253868	52
9	9.687616	9.941187	9.746429	10.253571	51
10	9.687842	9.941116	9.746716	10.253274	50
11	9.688069	9.941046	9.747023	10.252977	49
12	9.688295	9.940975	9.747319	20.252680	48
13	9.688523	9.940905	9.747616	10.252384	47
14	9.688747	9.940834	9.747912	10.252087	46
15	9.688972	9.940763	9.748209	10.251791	45
16	9.689198	9.940693	9.748505	10.251495	44
17	9.689421	9.940622	9.748801	10.251199	43
18	9.689648	9.940551	9.749097	10.250902	42
19	9.689873	9.940480	9.749393	10.250607	41
20	9.690098	9.940409	9.749689	10.250311	40
21	9.690323	9.940338	9.749985	10.250015	39
22	9.690548	9.940267	9.752281	10.249719	38
23	9.690772	9.940196	9.750576	10.249424	37
24	9.690996	9.940125	9.750872	10.249128	36
25	9.691220	9.940053	9.751167	10.248833	35
26	9.691444	9.939982	9.751462	10.248538	34
27	9.691668	9.939911	9.751757	10.248243	33
28	9.691892	9.939810	9.752052	10.247948	32
29	9.692115	9.939768	9.752317	10.247653	31
30	9.692339	9.939697	9.752642	10.247358	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Cosine	Tangent	Co-tang.	
30	9.692339	9.939697	9.752642	10.247358	30
31	9.692568	9.939625	9.752937	10.247063	29
32	9.692785	9.939554	9.753231	10.246769	28
33	9.693008	9.939482	9.753526	10.246474	27
34	9.693231	9.939410	9.753820	10.246180	26
35	9.693453	9.939339	9.754115	10.245885	25
36	9.693676	9.939267	9.754409	10.245591	24
37	9.693898	9.939195	9.754703	10.245297	23
38	9.694120	9.939123	9.754997	10.245003	22
39	9.694342	9.939051	9.755291	10.244709	21
40	9.694564	9.938980	9.755584	10.244415	20
41	9.694786	9.938908	9.755878	10.244122	19
42	9.695007	9.938835	9.756172	10.243828	18
43	9.695229	9.938763	9.756465	10.243535	17
44	9.695450	9.938691	9.756759	10.243241	16
45	9.695671	9.938619	9.757052	10.242948	15
46	9.695892	9.938547	9.757345	10.242655	14
47	9.696113	9.938475	9.757638	10.242362	13
48	9.696334	9.938402	9.757931	10.242069	12
49	9.696554	9.938330	9.758224	10.241776	11
50	9.696774	9.938257	9.758517	10.241483	10
51	9.696995	9.938185	9.758810	10.241190	9
52	9.697215	9.938112	9.759102	10.240898	8
53	9.697435	9.938040	9.759395	10.240605	7
54	9.697654	9.937967	9.759687	10.240313	6
55	9.697874	9.937895	9.759979	10.240021	5
56	9.698093	9.937822	9.760271	10.239728	4
57	9.698313	9.937749	9.760564	10.239436	3
58	9.698532	9.937676	9.760856	10.239144	2
59	9.698751	9.937603	9.761147	10.238852	1
60	9.698970	9.937531	9.761439	10.238561	0
	Cosine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.698970	9.937531	9.761439	10.238561	60
1	9.699189	9.937458	9.761731	10.238269	59
2	9.699407	9.937385	9.762022	10.237977	58
3	9.699626	9.937312	9.762314	10.237686	57
4	9.699844	9.937238	9.762606	10.237394	56
5	9.700062	9.937165	9.762897	10.237103	55
6	9.700280	9.937092	9.763188	10.236812	54
7	9.700498	9.937019	9.763479	10.236521	53
8	9.700716	9.936945	9.763770	10.236230	52
9	9.700933	9.936872	9.764061	10.235939	51
10	9.701151	9.936799	9.764352	10.235648	50
11	9.701368	9.936725	9.764643	10.235357	49
12	9.701585	9.936652	9.764933	10.235067	48
13	9.701802	9.936578	9.765224	10.234776	47
14	9.702019	9.936505	9.765514	10.234486	46
15	9.702236	9.936431	9.765805	10.234195	45
16	9.702452	9.936357	9.766095	10.233905	44
17	9.702669	9.936284	9.766385	10.233615	43
18	9.702885	9.936210	9.766675	10.233325	42
19	9.703101	9.936136	9.766965	10.233035	41
20	9.703317	9.936062	9.767255	10.232745	40
21	9.703533	9.935988	9.767545	10.232455	39
22	9.703748	9.935914	9.767834	10.232166	38
23	9.703964	9.935840	9.768124	10.231876	37
24	9.704179	9.935766	9.768413	10.231587	36
25	9.704395	9.935692	9.768703	10.231297	35
26	9.704610	9.935618	9.768992	10.231008	34
27	9.704825	9.935543	9.769281	10.230719	33
28	9.705040	9.935469	9.769570	10.230430	32
29	9.705254	9.935395	9.769859	10.230141	31
30	9.705469	9.935320	9.770148	10.229852	30
	Co-sine	Sine	Co-tang	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
	9.705469	9.935320	9.772148	10.227852	30
	9.705683	9.935246	9.770437	10.229563	29
	9.705897	9.935171	9.770726	10.229274	28
	9.706112	9.935097	9.771015	10.228985	27
	9.706326	9.935022	9.771303	10.228697	26
	9.706539	9.934948	9.771592	10.228408	25
	9.706753	9.934873	9.771880	10.228120	24
	9.706967	9.934798	9.772168	10.227832	23
	9.707180	9.934723	9.772456	10.227543	22
	9.707393	9.934648	9.772745	10.227255	21
	9.707606	9.934574	9.773033	10.226967	20
	9.707819	9.934499	9.773321	10.226679	19
	9.708032	9.934424	9.773608	10.226391	18
	9.708245	9.934345	9.773896	10.226104	17
	9.708457	9.934274	9.774184	10.225816	16
	9.708670	9.934199	9.774471	10.225529	15
	9.708882	9.934123	9.774759	10.225241	14
	9.709094	9.934048	9.775046	10.224954	13
	9.709306	9.933973	9.775333	10.224666	12
	9.709518	9.933897	9.775621	10.224379	11
	9.709730	9.933822	9.775908	10.224092	10
	9.709941	9.933747	9.776195	10.223805	9
	9.710153	9.933671	9.776482	10.223518	8
	9.710364	9.933596	9.776768	10.223232	7
	9.710575	9.933520	9.777055	10.222945	6
	9.710786	9.933444	9.777342	10.222658	5
	9.710997	9.933369	9.777628	10.222372	4
	9.711208	9.933293	9.777915	10.222085	3
	9.711418	9.933217	9.778201	10.221799	2
	9.711629	9.933141	9.778487	10.221513	1
	9.711839	9.933066	9.778774	10.221226	60
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.711839	9.933066	9.778774	10.221226	60
1	9.712049	9.932990	9.771000	10.220940	59
2	9.712259	9.932914	9.779346	10.220654	58
3	9.712469	9.932838	9.779632	10.220368	57
4	9.712679	9.932761	9.779918	10.220082	56
5	9.712889	9.932685	9.780203	10.219796	55
6	9.713098	9.932609	9.780489	10.219511	54
7	9.713308	9.932533	9.780775	10.219225	53
8	9.713517	9.932457	9.781060	10.218940	52
9	9.713726	9.932380	9.781346	10.218654	51
10	9.713935	9.932304	9.781631	10.218369	50
11	9.714144	9.932227	9.781916	10.218084	49
12	9.714352	9.932151	9.782202	10.217799	48
13	9.714561	9.932074	9.782486	10.217514	47
14	9.714769	9.931997	9.782771	10.217229	46
15	9.714977	9.931921	9.783056	10.216944	45
16	9.715186	9.931845	9.783341	10.216659	44
17	9.715394	9.931768	9.783626	10.216374	43
18	9.715601	9.941691	9.783910	10.216090	42
19	9.715809	9.931614	9.784195	10.215805	41
20	9.716017	9.931537	9.784479	10.215520	40
21	9.716224	9.931460	9.784764	10.215236	39
22	9.716431	9.931383	9.785048	10.214952	38
23	9.716639	9.821306	9.785332	10.214668	37
24	9.716846	9.931229	9.785616	10.214384	36
25	9.717051	9.931152	9.785900	10.214100	35
26	9.717259	9.931075	9.786184	10.213816	34
27	9.717456	9.930998	9.786468	10.213532	33
28	9.717672	9.930920	9.786752	10.213248	32
29	9.717869	9.930843	9.787036	10.212964	31
30	9.718085	9.930766	9.787319	10.212681	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.7 8085	9.93076	9.78731.	10.21.081	30
31	9.7 8 91	9.930688	9.787603	10.212397	29
32	9.718447	9.910611	9.787886	10.212114	28
33	9.718 703	9.9.0533	9.788170	10.211830	27
34	9.718009	9.930456	9.788453	10.211547	26
35	9.719114	9.930378	9.788736	10.211264	25
36	9.719320	9.930300	9.789019	10.310698	24
37	9.719525	9.930223	9.789302	10 216658	23
38	9.719730	9.93014.	9.789 85	10.210415	22
39	9.719935	9.930067	9.789868	10.210132	21
40	9.720140	9.92989	9.79 151	10.209849	20
41	9.720345	9.939911	9.797433	10.209566	19
42	9.720549	.92983	974 716	10.2 9284	18
43	9.720754	9.929755	9.79 999	10.200001	17
44	9. 2 958	9.92.677	9.79 0281	10.208719	16
45	9.721161	9.929599	9.791563	10.208436	15
46	9.721366	9.9. 952.	9.791846	10.208154	14
47	9.71570	9.929442	9.792128	10.207872	13
48	9.721771	9.929364	9.792410	10.207590	12
49	9.721978	9.929286	9.79 692	10.207308	11
50	9.722181	9.92.207	9.792974	10.207044	10
51	9.722385	9.929129	9. 93256	10.206744	9
52	9.722588	9.929050	9.793338	10.206462	8
53	9.722791	9.928978	9.793819	10.206180	7
54	9.722994	9.928893	9.794101	10.205899	6
55	9.723197	9.92881.	9.794383	10.205627	5
56	9.723400	9.928736	9.794664	10.205338	4
57	9.723603	9.928657	9.794945	10.205054	3
58	9.723805	9.928578	9.795227	10.204773	2
59	9.724007	9.928499	9.795508	10.204492	1
60	9.724209	9.928420	9.795789	10.204211	0

| | Cosine | Sine | Co-tang | Tangent | M |

M	Sine	Co-sine	Tangent	Co-ang.	
0	9.724210	9.928430	9.795789	10.204211	60
1	9.724412	9.928341	9.796070	10.203930	59
2	9.724614	9.928262	9.796351	10.203649	58
3	9.724816	9.928183	9.796632	10.203368	57
4	9.725017	9.928104	9.796913	10.203087	56
5	9.725219	9.928025	9.797194	10.202806	55
6	9.725420	9.927946	9.797474	10.202522	54
7	9.725622	9.927867	9.797755	10.202245	53
8	9.725823	9.927787	9.798036	10.201964	52
9	9.726024	9.927708	9.798316	10.201684	51
10	9.726225	9.927628	9.798596	10.201404	50
11	9.726426	9.927549	9.798877	10.201113	49
12	9.726626	9.927469	9.799157	10.200843	48
13	9.726827	9.927390	9.799437	10.200563	47
14	9.727027	9.927310	9.799717	10.200283	46
15	9.727228	9.927231	9.799997	10.200003	45
16	9.727428	9.927151	9.800277	10.199723	44
17	9.727628	9.927071	9.800557	10.199443	43
18	9.727828	9.926991	9.800836	10.199163	42
19	9.728027	9.926911	9.801116	10.198884	41
20	9.728227	9.926831	9.801396	10.198604	40
21	9.728427	9.926751	9.801675	10.198325	39
22	9.728626	9.926671	9.801955	10.198045	38
23	9.728825	9.926591	9.802234	10.197766	37
24	9.729024	9.926511	9.802513	10.197487	36
25	9.729223	9.926431	9.802792	10.197207	35
26	9.729422	9.926351	9.803072	10.196928	34
27	9.729621	9.926270	9.803351	10.196649	33
28	9.729820	9.926190	9.803630	10.196370	32
29	9.730018	9.926110	9.803908	10.196091	31
30	9.730216	9.926029	9.804187	10.195813	30
	Co-sine	Sine	Co-ang.	Tangent	M

M	Sine	Cosine	Tangent	Cotang.	
	9.730216	9.926079	9.804187	10.195813	30
31	9.730415	9.925949	9.904466	10.195534	29
32	9.730612	9.925868	9.804745	10.195255	28
33	9.730811	9.925787	9.805023	10.194979	27
34	9.731009	9.925707	9.805302	10.194698	26
35	9.731206	9.925626	9.805580	10.194420	25
36	9.731404	9.925545	9.805859	10.194141	24
37	9.731601	9.925464	9.806137	10.193863	23
38	9.731799	9.925384	9.806415	10.193585	22
39	9.731996	9.925303	9.806693	10.193309	21
40	9.732193	9.925222	9.806971	10.191028	20
41	9.732390	9.925141	9.807249	10.192751	19
42	9.732587	9.925060	9.807527	10.192433	18
43	9.732784	9.924978	9.807805	10.192195	17
44	9.732980	9.924897	9.808083	10.191917	16
45	9.733177	9.924816	9.808361	10.191639	15
46	9.733373	9.924735	9.808638	10.191362	14
47	9.733569	9.924653	9.808916	10.191084	13
48	9.733765	9.924572	9.809193	10.190807	12
49	9.733961	9.924491	9.809471	10.190529	11
50	9.734157	9.924409	9.809748	10.190252	10
51	9.734353	9.924328	9.810025	10.189975	9
52	9.734548	9.924246	9.810302	10.189697	8
53	9.734744	9.924164	9.810580	10.189420	7
54	9.734939	9.924083	9.810857	10.189143	6
55	9.735134	9.924001	9.811134	10.188866	5
56	9.735330	9.923919	9.811410	10.188589	4
57	9.735525	9.923837	9.811687	10.188313	3
58	9.735719	9.923755	9.811964	10.188036	2
59	9.735914	9.923673	9.812241	10.187759	1
60	9.736109	9.923591	9.812517	10.187483	0
	Cosine	Sine	Cotang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang	
0	9.73610,	9.923591	9.812517	10.187493	60
1	9.736309	9.923501	9.812794	10.187206	59
2	9.736497	9.923421	9.813070	10.186930	58
3	9.736692	9.923341	9.813347	10.186653	57
4	9.736986	9.923263	9.813623	10.186377	56
5	9.737082	9.923183	9.813899	10.186101	55
6	9.737274	9.923098	9.814175	10.185824	54
7	9.737467	9.923016	9.814452	10.185548	53
8	9.737661	9.922932	9.814728	10.185272	52
9	9.737854	9.922851	9.815004	10.184996	51
10	9.738048	9.922768	9.815279	10.184720	50
11	9.738241	9.922680	9.815555	10.184445	49
12	9.738434	9.922601	9.815831	10.184169	48
13	9.738627	9.922520	9.816107	10.183893	47
14	9.738820	9.922438	9.816383	10.183617	46
15	9.739013	9.922355	9.816658	10.183342	45
16	9.739205	9.922272	9.816933	10.183066	44
17	9.739398	9.922189	9.817209	10.182791	43
18	9.739590	9.922106	9.817484	10.182516	42
19	9.739783	9.922023	9.817759	10.182240	41
20	9.739975	9.921940	9.818035	10.181965	40
21	9.740167	9.921857	9.818310	10.181690	39
22	9.740159	9.921773	9.818585	10.181415	38
23	9.740552	9.921690	9.818860	10.181140	37
24	9.740743	9.921606	9.819135	10.180865	36
25	9.740933	9.921522	9.819410	10.180590	35
26	9.741125	9.921441	9.819684	10.180315	34
27	9.741316	9.921355	9.819959	10.180041	33
28	9.741507	9.921274	9.820234	10.179766	32
29	9.741698	9.921190	9.820508	10.179492	31
30	9.741889	9.921110	9.820783	10.179217	30
	Co-sine	Sine	Co-tang	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.741889	9.922107	9.820783	10.179217	30
31	9.742080	9.92102	9.821057	10.178942	29
32	9.742271	9.92 2935	9.821332	10.178668	28
33	9.742461	9.920835	9.821606	10.178394	27
34	9.742652	9.920770	9.821880	10.178120	26
35	9.742842	9.920688	9.822154	10.177846	25
36	9.743032	9.920606	9.822429	10.177571	24
37	9.743223	9.920523	9.822703	10.177297	23
38	9.743413	9.920439	9.822977	10.177023	22
39	9.743602	9.920352	9.823250	10.176739	21
40	9.743791	9.920268	9.823524	10.176476	20
41	9.743982	9.920184	9.823798	10.176202	19
42	9.744171	9.920009	9.824072	10.175928	18
43	9.744361	9.920015	9.824345	10.175655	17
44	9.744550	9.919931	9.824619	10.175381	16
45	9.744739	9.919846	9.824892	10.175108	15
46	9.744928	9.919761	9.825166	10.174834	14
47	9.745117	9.919677	9.825439	10.174560	13
48	9.745306	9.919593	9.825713	10.174287	12
49	9.745494	9.919508	9.825986	10.174014	11
50	9.745683	9.919423	9.826259	10.173741	10
51	9.745871	9.919339	9.826532	10.173468	9
52	9.746059	9.919254	9.826805	10.173195	8
53	9.746248	9.919169	9.827078	10.172922	7
54	9.746436	9.919084	9.827351	10.172649	6
55	9.746624	9.918999	9.827624	10.172376	5
56	9.746811	9.918915	9.827897	10.172103	4
57	9.746999	9.918830	9.828170	10.171830	3
58	9.747187	9.918744	9.828442	10.171558	2
59	9.747374	9.918659	9.828715	10.171285	1
60	9.747562	9.918574	9.828987	10.171012	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.742562	9.918574	9.828987	12.171013	60
1	9.747749	9.918489	9.829260	10.170740	59
2	9.747936	9.918404	9.829532	10.170468	58
3	9.748123	9.918318	9.829805	10.170195	57
4	9.748310	9.918233	9.830077	10.169923	56
5	9.748497	9.918147	9.830349	10.169651	55
6	9.748683	9.918062	9.830621	10.169379	54
7	9.748870	9.917976	9.830893	10.169106	53
8	9.749057	9.917891	9.831165	10.168834	52
9	9.749242	9.917805	9.831437	10.168563	51
10	9.749429	9.917719	9.831705	10.168291	50
11	9.749615	9.917634	9.831981	10.168019	49
12	9.749801	9.917548	9.832253	10.167747	48
13	9.749986	9.917462	9.832525	10.167475	47
14	9.750172	9.917376	9.832796	10.167204	46
15	9.750358	9.917290	9.833068	10.166932	45
16	9.750543	9.917204	9.833339	10.166660	44
17	9.750729	9.917118	9.833611	10.166389	43
18	9.750914	9.917032	9.833882	10.166118	42
19	9.751099	9.916945	9.834154	10.165846	41
20	9.751284	9.916859	9.834425	10.165575	40
21	9.751469	9.916773	9.834696	10.165304	39
22	9.751654	9.916686	9.834967	10.165033	38
23	9.751838	9.916600	9.835238	10.164762	37
24	9.752023	9.916514	9.835505	10.164491	36
25	9.752107	9.916427	9.835780	10.164220	35
26	9.752392	9.916240	9.836051	10.163949	34
27	9.752576	9.916254	9.836322	10.163678	33
28	9.752760	9.916167	9.836593	10.163407	32
29	9.752944	9.916080	9.836864	10.163136	31
30	9.753128	9.915994	9.837134	10.162866	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
30	9.753128	9.915994	9.837134	10.126846	30
31	9.753312	9.915907	9.837405	10.162595	29
32	9.753495	9.915820	9.837675	10.162325	28
33	9.753679	9.915733	9.837946	10.162054	27
34	9.753862	9.915646	9.838216	10.161784	26
35	9.754046	9.915559	9.838487	10.161513	25
36	9.754229	9.915472	9.838757	10.161243	24
37	9.754412	9.915385	9.839027	10.160973	23
38	9.754595	9.915297	9.839297	10.160702	22
39	9.754778	9.915210	9.839568	10.160432	21
40	9.754960	9.915123	9.839838	10.160162	20
41	9.755143	9.915035	9.840108	10.159892	19
42	9.755325	9.914948	9.840378	10.159622	18
43	9.755508	9.914860	9.840647	10.159352	17
44	9.755690	9.914772	9.840917	10.159083	16
45	9.755872	9.914685	9.841187	10.158813	15
46	9.756054	9.914597	9.841457	10.158543	14
47	9.756236	9.914510	9.841726	10.158273	13
48	9.756418	9.914422	9.841996	10.158004	12
49	9.756600	9.914334	9.842266	10.157734	11
50	9.756781	9.914246	9.842535	10.157465	10
51	9.756963	9.914158	9.842804	10.157195	9
52	9.757144	9.914070	9.843074	10.146926	8
53	9.757326	9.913982	9.843343	10.156657	7
54	9.757507	9.913894	9.843612	10.156387	6
55	9.757688	9.913806	9.843882	10.156118	5
56	9.757869	9.913718	9.844151	10.155849	4
57	9.758049	9.913630	9.844420	10.155580	3
58	9.758230	9.913542	9.844689	10.155331	2
59	9.758411	9.913453	9.844958	10.155042	1
60	9.758591	9.913364	9.845227	10.154774	0
	Co-fine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.758591	9.913264	9.845327	10.154673	60
1	9.758771	9.913276	9.845496	10.154504	59
2	9.758952	9.913187	9.845764	10.154233	58
3	9.759132	9.913097	9.846033	10.153967	57
4	9.759312	9.913010	9.846302	10.153698	56
5	9.759492	9.912920	9.846570	10.153429	55
6	9.759672	9.912831	9.846839	10.153161	54
7	9.759851	9.912744	9.847107	10.152892	53
8	9.760031	9.912653	9.847376	10.152624	52
9	9.760210	9.912566	9.847644	10.152356	51
10	9.760390	9.912477	9.847913	10.152087	50
11	9.760569	9.912386	9.848181	10.151819	49
12	9.760748	9.912299	9.848449	10.151551	48
13	9.760927	9.912210	9.848717	10.151283	47
14	9.761106	9.912121	9.848985	10.151015	46
15	9.761285	9.912031	9.849254	10.150746	45
16	9.761464	9.911942	9.849522	10.150478	44
17	9.761642	9.911853	9.849789	10.150215	43
18	9.761821	9.911763	9.850057	10.149943	42
19	9.761999	9.911674	9.850325	10.149675	41
20	9.762177	9.911584	9.850593	10.149407	40
21	9.762356	9.911495	9.850861	10.149139	39
22	9.762534	9.911405	9.851128	10.148872	38
23	9.762712	9.911315	9.851396	10.148604	37
24	9.762889	9.911226	9.851664	10.148336	36
25	9.763067	9.911136	9.851931	10.148069	35
26	9.763245	9.911046	9.852199	10.147801	34
27	9.763422	9.910956	9.852466	10.147534	33
28	9.763599	9.910866	9.852734	10.147266	32
29	9.763777	9.910776	9.853001	10.146999	31
30	9.763954	9.910686	9.853268	10.146732	30

| | Co-sine | Sine | Co-tang. | Tangent | M |

Degree 35.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.703954	9.91068.	9.853268	10.146732	30
31	9.76411	9.910590	9.853532	10.146465	29
32	9.764306	9.910500	9.853802	10.146198	28
33	9.764485	9.91041	9.854069	10.145930	27
34	9.764662	9.910325	9.854336	10.145664	26
35	9.764838	9.910235	9.854603	10.145397	25
36	9.765015	9.910144	9.854870	10.145130	24
37	9.765191	9.910054	9.855137	10.144863	23
38	9.765367	9.909963	9.855404	10.144596	22
39	9.765544	9.909873	9.855671	10.144329	21
40	9.765720	9.909782	9.855937	10.144063	20
41	9.765896	9.909691	9.856204	10.143796	19
42	9.766071	9.909601	9.856471	10.143529	18
43	9.766247	9.909510	9.856737	10.143263	17
44	9.766423	9.909419	9.857004	10.142996	16
45	9.766598	9.909328	9.857270	10.142730	15
46	9.766774	9.909237	9.857537	10.142463	14
47	9.766949	9.909146	9.857803	10.142197	13
48	9.767124	9.909055	9.858069	10.141931	12
49	9.767299	9.908964	9.858336	10.141664	11
50	9.767474	9.908873	9.858602	10.141398	10
51	9.767649	9.908781	9.858868	10.141132	9
52	9.767824	9.908690	9.859134	10.140166	8
53	9.767997	9.908599	9.859400	10.140600	7
54	9.768173	9.908508	9.859666	10.140334	6
55	9.768348	9.908415	9.859932	10.140068	5
56	9.768522	9.908324	9.860198	10.139802	4
57	9.768696	9.908233	9.860464	10.139536	3
58	9.768871	9.908141	9.860730	10.139270	2
59	9.769045	9.908049	9.860995	10.139005	1
60	9.769219	9.907958	9.861261	10.138739	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 54.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.769219	9.907958	9.861261	10.128739	60
1	9.769392	9.907866	9.861527	10.138473	59
2	9.769566	9.907774	9.861792	10.128208	58
3	9.769740	9.907682	9.862058	10.137942	57
4	9.769913	9.907590	9.862323	10.137677	56
5	9.770087	9.907498	9.862589	10.137411	55
6	9.770260	9.907406	9.862854	10.137146	54
7	9.770433	9.907314	9.863119	10.136880	53
8	9.770606	9.907221	9.863385	10.136615	52
9	9.770779	9.907129	9.863650	10.136350	51
10	9.770952	9.907037	9.863915	10.136085	50
11	9.771125	9.906945	9.864180	10.135820	49
12	9.771298	9.906852	9.864445	10.135554	48
13	9.771470	9.906760	9.864710	10.135289	47
14	9.771643	9.906667	9.864975	10.135024	46
15	9.771815	9.906574	9.865240	10.134759	45
16	9.771987	9.906482	9.865505	10.134495	44
17	9.772159	9.906389	9.865770	10.134230	43
18	9.772331	9.906296	9.866035	10.133965	42
19	9.772503	9.906203	9.866300	10.133700	41
20	9.772675	9.906111	9.866564	10.133436	40
21	9.772847	9.906018	9.866829	10.133171	39
22	9.773018	9.905923	9.867094	10.132906	38
23	9.773190	9.905832	9.867358	10.132642	37
24	9.773361	9.905738	9.867613	10.132377	36
25	9.773533	9.905645	9.867887	10.132113	35
26	9.773704	9.905552	9.868152	10.131848	34
27	9.773875	9.905459	9.868416	10.131584	33
28	9.774046	9.905365	9.868680	10.131320	32
29	9.774217	9.905272	9.868945	10.131055	31
30	9.774388	9.905179	9.869209	10.130791	30
	Co-sine	Sine	Co-tang.	Tangent	M

	Sine	Co-sine	Tangent	Co-tang.	
30	9.774388	9.905179	9.869209	10.130791	30
29	9.774558	9.905085	9.864773	10.130527	29
28	9.774729	9.904992	9.867337	10.130263	28
27	9.774899	9.904898	9.870001	12.129999	27
26	9.775070	9.904804	9.870265	10.129735	26
25	9.775240	9.904711	9.870529	10.129471	25
24	9.775410	9.904617	9.870793	12.129207	24
23	9.775580	9.904523	9.871057	10.128943	23
22	9.775750	9.904429	9.871321	10.128679	22
21	9.775920	9.9 4335	9.871585	10.128415	21
20	9.776090	9.904241	9.871849	10.128151	20
19	9.776259	9.904147	9.872112	10.127888	19
18	9.776429	9.904053	9.872376	10.127624	18
17	9.776598	9.903959	9.872640	10.127360	17
16	9.776768	9.903864	9.872903	10.127097	16
15	9.776937	9.903770	9.873167	10.126833	15
14	9.777106	9.903676	9.873430	10.126570	14
13	9.777275	9.903581	9.873694	10.126306	13
12	9.777444	9.903486	9.873957	10.126043	12
11	9.777613	9.903392	9.874220	10.125780	11
10	9.777781	9.903298	9.874484	10.125516	10
9	9.777950	9.903203	9.874747	10.125253	9
8	9.778119	9.903108	9.875010	10.114990	8
7	9.778287	9.903013	9.875273	10.124727	7
6	9.778455	9.902919	9.875536	10.124464	6
5	9.778623	9.902824	9.875799	10.124201	5
4	9.778792	9.902729	9.876063	1:.123937	4
3	9.778960	9.902634	9.876326	10.123674	3
2	9.779129	9.902539	9.876589	10.123411	2
1	9.779295	9.902444	9.876851	10.123149	1
0	9.779463	9.902349	9.877114	10.112885	M
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.779465	9.902349	9.877114	10.122885	60
1	9.779631	9.902254	9.877377	10.122623	59
2	9.779798	9.902158	9.877640	10.122360	58
3	9.779965	9.902063	9.877903	10.122097	57
4	9.780133	9.901967	9.878165	10.121834	56
5	9.780300	9.901872	9.878428	10.121572	55
6	9.780467	9.901776	9.878691	10.121309	54
7	9.780634	9.901681	9.878953	10.121047	53
8	9.780801	9.901585	9.879216	10.120784	52
9	9.780968	9.901488	9.879478	10.120522	51
10	9.781134	9.901391	9.879741	10.120259	50
11	9.781301	9.901298	9.880003	10.119997	49
12	9.781467	9.901202	9.880265	10.119734	48
13	9.781694	9.901106	9.880528	10.119472	47
14	9.781800	9.901010	9.880790	10.119210	46
15	9.781966	9.900914	9.881052	10.118948	45
16	9.782132	9.900828	9.881314	10.118686	44
17	9.782298	9.900722	9.881576	10.118424	43
18	9.782464	9.900626	9.881839	10.118161	42
19	9.782630	9.900529	9.882101	10.117899	41
20	9.782796	9.900433	9.882363	10.117637	40
21	9.782961	9.900337	9.882625	10.117375	39
22	9.783127	9.900240	9.882886	10.117114	38
23	9.783292	9.900144	9.883148	10.116852	37
24	9.783457	9.900047	9.883410	10.116590	36
25	9.783623	9.899951	9.883672	10.116328	35
26	9.783788	9.899854	9.883934	10.116066	34
27	9.783953	9.899757	9.884195	10.115805	33
28	9.784118	9.899660	9.884457	10.115543	32
29	9.784282	9.899563	9.884719	10.115281	31
30	9.784447	9.899467	9.884980	10.115020	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 37.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.784447	9.899467	9.884980	10.115020	30
31	9.784676	9.899373	9.885242	10.114758	29
32	9.784776	9.899273	9.885503	10.114497	28
33	9.784948	9.899175	9.885765	10.114235	27
4	9.785105	9.899078	9.886026	10.113974	26
35	9.785209	9.898981	9.886288	10.113712	25
36	9.785433	9.898884	9.886549	10.113451	24
	9.785591	9.892787	9.886810	10.113190	23
	9.785761	9.898689	9.887072	10.112928	22
	9.785925	9.898592	9.887333	10.112667	21
	9.786088	9.898494	9.887594	10.112406	20
	9.786152	9.898397	9.887855	10.112145	18
	9.786416	9.898299	9.888116	10.111884	17
	9.786179	9.898201	9.888377	10.111623	16
	9.786742	9.898104	9.888638	10.111362	15
	9.786909	9.898006	9.888899	10.111101	14
46	9.787069	9.897908	9.889160	10.110840	14
	9.787232	9.897810	9.889421	10.110579	13
	9.787395	9.897712	9.889682	10.110318	12
	9.787557	9.897614	9.889943	10.110057	11
50	9.787720	9.897516	9.890204	10.109796	10
51	9.787883	9.897418	9.890465	10.109535	9
	9.788045	9.897320	9.890725	10.109275	8
53	9.788208	9.897222	9.890986	10.109014	7
	9.788370	9.897123	9.891247	10.108753	6
55	9.788532	9.897025	9.891507	10.108492	5
	9.788694	9.896926	9.891768	10.108232	4
	9.788856	9.896828	9.892028	10.107972	3
	9.789018	9.896729	9.892289	10.107711	2
	9.789180	9.896631	9.892549	10.107451	1
	9.789342	9.896532	9.892810	10.107190	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 52.

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.789312	9.896532	9.892810	10.107190	60
1	9.789504	9.896433	9.893070	10.106930	59
2	9.789665	9.896335	9.893330	10.106669	58
3	9.789827	9.896236	9.893591	10.106449	57
4	9.789988	9.896137	9.893851	10.106149	56
5	9.790149	9.896038	9.894111	10.105889	55
6	9.790310	9.895939	9.894371	10.105628	54
7	9.790471	9.895840	9.894632	10.105368	53
8	9.790632	9.895741	9.894892	10.105108	52
9	9.790793	9.895641	9.895152	10.104848	51
10	9.790954	9.895542	9.895412	10.104588	50
11	9.791115	9.895443	9.895672	10.104328	49
12	9.791275	9.895343	9.895932	10.104068	48
13	9.971436	9.895244	9.896192	10.103808	47
14	9.791596	9.895144	9.896452	10.103548	46
15	9.791756	9.895045	9.896712	10.103288	45
16	9.791917	9.894945	9.896971	10.103028	44
17	9.792077	9.894845	9.897231	10.102769	43
18	9.792237	9.894746	9.897491	10.102509	42
19	9.792397	9.894646	9.897751	10.102249	41
20	9.792557	9.894546	9.898010	10.101990	40
21	9.792716	9.894446	9.898270	10.101730	39
22	9.792876	9.894346	9.898530	10.101470	38
23	9.793035	9.894246	9.898789	10.101211	37
24	9.793195	9.894146	9.899049	10.100951	36
25	9.793354	9.894046	9.899308	10.100692	35
26	9.793513	9.893945	9.899568	10.100432	34
27	5.793673	9.893845	9.899827	10.100173	33
28	9.793832	9.893745	9.900086	10.099913	32
29	9.793991	9.893645	9.900346	10.099654	31
30	9.794149	9.893544	9.900605	10.099395	30

	Co-sine	Sine	Co-tang.	Tangent	M

M.	Sine	Co-sine	Tangent	Co-tang.	
30	9.794149	9.893544	9.900605	10.099395	30
31	9.794308	9.893444	9.900864	10.099135	29
32	9.794467	9.893343	9.901124	10.098876	28
33	9.794626	9.893243	9.901383	10.098617	27
34	9.794784	9.893142	9.901642	10.098358	26
35	9.794942	9.893041	9.901901	10.098099	25
36	9.795101	9.892940	9.902160	10.097839	24
37	9.795259	9.892839	9.902419	10.097580	23
38	9.795417	9.892738	9.902678	10.097321	22
39	9.795575	9.892637	9.902937	10.097062	21
40	9.795733	9.892536	9.903196	10.096803	20
41	9.795891	9.892435	9.903455	10.096544	19
42	9.796049	9.892334	9.903714	10.096285	18
43	9.796206	9.892233	9.903973	10.096027	17
44	9.796364	9.892132	9.904232	10.095768	16
45	9.796521	9.892030	9.904491	10.095509	15
46	9.796678	9.891929	9.904750	10.095250	14
47	9.796836	9.891827	9.905008	10.094991	13
48	9.796993	9.891726	9.905267	10.094733	12
49	9.797150	9.891624	9.905526	10.094474	11
50	9.797307	9.891522	9.905784	10.094215	10
51	9.797464	9.891421	9.906043	10.093957	9
52	9.797621	9.891319	9.906302	10.093698	8
53	9.797777	9.891217	9.906560	10.093440	7
54	9.797934	9.891115	9.906819	10.093181	6
55	9.798091	9.891013	9.907077	10.092923	5
56	9.798247	9.890911	9.907336	10.092664	4
57	9.798403	9.890809	9.907594	10.092406	3
58	9.798560	9.890707	9.907852	10.092147	2
59	9.798716	9.890605	9.908111	10.091889	1
60	9.798872	9.890503	9.908369	10.091631	0
	Co-sine	Sine	Co-tang.	Tang.	

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M	Sine	Co-sine	Tangent	Co-tang.	
0	9.798872	9.890503	9.908369	10.091631	60
1	9.799028	9.890400	9.908627	10.091373	59
2	9.799184	9.890298	9.908886	10.091114	58
3	9.799339	9.890195	9.909144	10.090856	57
4	9.799495	9.890093	9.909402	10.090593	56
5	9.799651	9.889990	9.909660	10.090340	55
6	9.799806	9.889888	9.909918	10.090081	54
7	9.799961	9.889785	9.910176	10.089821	53
8	9.800117	9.889682	9.910435	10.089565	52
9	9.800272	9.889579	9.910693	10.089307	51
10	9.800427	9.889476	9.910951	10.089049	50
11	9.800582	9.889374	9.911209	10.088791	49
12	9.800737	9.889271	9.911467	10.088533	48
13	9.800892	9.889167	9.911724	10.088275	47
14	9.801047	9.889064	9.911982	10.088017	46
15	9.801201	9.888961	9.912240	10.087760	45
16	9.801356	9.888858	9.912498	10.087502	44
17	9.801510	9.888755	9.912756	10.087244	43
18	9.801665	9.888651	9.913014	10.086986	42
19	9.801819	9.888548	9.913271	10.086729	41
20	9.801973	9.888444	9.913529	10.086471	40
21	9.802127	9.888341	9.913787	10.085213	39
22	9.802282	9.888237	9.914044	10.085956	38
23	9.802435	9.888133	9.914302	10.085698	37
24	9.802589	9.888030	9.914560	10.085440	36
25	9.802743	9.887926	9.614817	10.085183	35
26	9.802897	9.887822	9.915075	10.084925	34
27	9.803050	9.887718	9.915332	10.084668	33
28	9.803204	9.887614	9.915590	10.084410	32
29	9.803357	9.887510	9.915847	10.084153	31
30	9.803510	9.887406	9.916104	10.083895	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.803510	9.887406	9.916104	10.083895	30
31	9.803664	9.887300	9.916362	10.083638	29
32	9.803817	9.887198	9.916619	10.083381	28
33	9.803970	9.887090	9.916876	10.083123	27
34	9.804123	9.886989	9.917134	10.082866	26
35	9.804276	9.886884	9.917391	10.082609	25
36	9.804428	9.886780	9.917648	10.082352	24
37	9.804581	9.886675	9.917995	10.082094	23
38	9.804734	9.886571	9.918162	10.081837	22
39	9.804886	9.886466	9.918420	10.081580	21
40	9.805038	9.886361	9.918677	10.081323	20
41	9.805191	9.886257	9.918934	10.081006	19
42	9.805343	9.886152	9.919191	10.080809	18
43	9.805495	9.886047	9.919448	10.080552	17
44	9.805647	9.885942	9.919705	10.080295	16
45	9.805799	9.885837	9.919962	10.080038	15
46	9.805951	9.885732	9.920219	10.079781	14
47	9.806103	9.885627	9.920476	10.079524	13
48	9.806254	9.885521	9.920733	10.079267	12
49	9.806406	9.885416	9.920990	10.079010	11
50	9.806557	9.885311	9.921247	10.078753	10
51	9.806709	9.885205	9.921503	10.078496	9
52	9.806860	9.885100	9.921760	10.078240	8
53	9.807011	9.884994	9.922017	10.077983	7
54	9.807162	9.884889	9.922274	10.077726	6
55	9.807313	9.884783	9.922530	10.077469	5
56	9.807464	9.884677	9.922787	10.077213	4
57	9.807615	9.884572	9.923044	10.076956	3
58	9.807766	9.884466	9.923300	10.076699	2
59	9.807917	9.884360	9.922557	10.076443	1
60	9.808067	9.884254	9.923813	10.075186	0

Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.808067	9.884254	9.923813	10 076186	60
1	9.808218	9.884148	9.924070	10.075930	59
2	9.808368	9.884042	9.924327	10.075673	58
3	9.808519	9.883936	9.924583	10.075417	57
4	9.808669	9.883829	9.924839	10.075160	56
5	9.808819	9.883723	9.925096	10.074904	55
6	9.808969	9.883617	9.925352	10.074647	54
7	9.809119	9.883510	9.925609	10.074391	53
8	9.809269	9.883404	9.925865	10.074135	52
9	9.809419	9.883297	9.926121	10.073878	51
10	9.809569	9.883191	9.926378	10.073622	50
11	9.809718	9.883084	9.926634	10.073366	49
12	9.809868	9.882977	9.926890	10.073110	48
13	9.810017	9.882871	9.927147	10.072853	47
14	9.810166	9.882764	9.927403	10.072597	46
15	9.810316	9.882657	9.927659	10.072341	45
16	9.810465	9.882550	9.927915	10.072085	44
17	9.810614	9.882443	9.928171	10.071829	43
18	9.810763	9.882336	9.928427	10.071573	42
19	9.810912	9.882228	9.928683	10.071316	41
20	9.811061	9.882121	9.928940	10.071060	40
21	9.811210	9.882014	9.929196	10.070804	39
22	9.811358	9.881907	9.929452	10.070548	38
23	9.811506	9.881799	9.929708	10.070292	37
24	9.811655	9.881692	9.929964	10.070036	36
25	9.811804	9.881584	9.930219	10.069781	35
26	9.811952	9.881477	9.930475	10.069525	34
27	9.812100	9.881369	9.930731	10.069269	33
28	9.812248	9.881261	9.930987	10.069013	32
29	9.812356	9.881153	9.931243	10.068757	31
30	9.812544	9.881045	9.931499	10.068501	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.812544	9.881045	9.931499	10.068501	30
31	9.812692	9.880937	9.931755	10.068245	29
32	9.812840	9.880825	9.932010	10.067989	28
33	9.812988	9.880721	9.932266	10.067734	27
34	9.813135	9.880613	9.932522	10.067478	26
35	9.813283	9.880503	9.932778	10.067222	25
36	9.813430	9.880397	9.933033	10.066967	24
37	9.813578	9.880288	9.933289	10.066711	23
38	9.813725	9.880180	9.933545	10.066455	22
39	9.813872	9.880072	9.933800	10.066200	21
40	9.814019	9.879963	9.934056	10.065944	20
41	9.814166	9.879855	9.934311	10.065688	19
42	9.814313	9.879746	9.934567	10.065433	18
43	9.814460	9.879637	9.934822	10.065177	17
44	9.814607	9.879529	9.935078	10.064922	16
45	9.814753	9.879420	9.935333	10.064666	15
46	9.814900	9.879311	9.935589	10.064411	14
47	9.815046	9.879202	9.935844	10.064156	13
48	9.815193	9.879093	9.936100	10.063900	12
49	9.815339	9.878984	9.936355	10.063645	11
50	9.815485	9.878875	9.936610	10.063389	10
51	9.815631	9.878766	9.936866	10.063124	9
52	9.815777	9.878656	9.937121	10.062879	8
53	9.815923	9.878547	9.937376	10.062623	7
54	9.816069	9.878438	9.937632	10.062368	6
55	9.816215	9.878328	9.937887	10.062113	5
56	9.816361	9.878219	9.938142	10.061858	4
57	9.816506	9.878109	9.938397	10.061602	3
58	9.816652	9.877999	9.938652	10.061347	2
59	9.816797	9.877890	9.938908	10.061092	1
60	9.816943	9.877780	9.939163	10.060837	0
	Co-sine	Sine	Co-tang	Tangent	M

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	Degree 41.				
M	Sine	Co-sine	Tangent	Co-tang.	
0	9.816943	9.877780	9.939163	10.060837	60
1	9.817088	9.877670	9.939418	10.060582	59
2	9.817233	9.877560	9.939673	10.060327	58
3	9.817378	9.877450	9.939928	10.060072	57
4	9.817523	9.877340	9.940183	10.059816	56
5	9.817668	9.877230	9.940438	10.059562	55
6	9.817813	9.877120	9.940693	10.059307	54
7	9.817958	9.877009	9.940948	10.059052	53
8	9.818103	9.876899	9.941203	10.058797	52
9	9.818247	9.876789	9.941458	10.058542	51
10	9.818392	9.876678	9.941713	10.058287	50
11	9.818536	9.876568	9.941968	10.058032	49
12	9.818681	9.876457	9.942223	10.057777	48
13	9.818825	9.876347	9.942478	10.057522	47
14	9.818969	9.876236	9.942732	10.057267	46
15	9.819113	9.876125	9.942988	10.057012	45
16	9.819257	9.876014	9.943243	10.056757	44
17	9.819401	9.875904	9.943498	10.056502	43
18	9.819545	9.875793	9.943752	10.056248	42
19	9.819689	9.875682	9.944007	10.055993	41
20	9.819832	9.875571	9.944262	10.055738	40
21	9.819976	9.875459	9.944517	10.055483	39
22	9.820119	9.875348	9.944771	10.055229	38
23	9.820263	9.875237	9.945026	10.054974	37
24	9.820406	9.875125	9.945281	10.054719	36
25	9.820549	9.875014	9.945535	10.054464	35
26	9.820693	9.874903	9.945790	10.054210	34
27	9.820836	9.874791	9.946045	10.053955	33
28	9.820979	9.874679	9.946299	10.053701	32
29	9.821122	9.874568	9.946554	10.053446	31
30	9.821264	9.874456	9.946808	10.053192	30
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 48.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.821264	9.874456	9.946808	10.053192	30
31	9.821407	9.874363	9.947063	10.052937	29
32	9.821559	9.874217	9.947317	10.052682	28
33	9.821692	9.874172	9.947572	10.052428	27
34	9.821835	9.174038	9.947826	10.052173	26
35	9.821977	9.873896	9.948081	10.051919	25
36	9.822120	9.873784	9.948335	10.051664	24
37	9.822262	9.873672	9.948590	10.051410	23
38	9.822404	9.873560	9.948844	10.011156	22
39	9.822546	9.873447	9.949099	10.050901	21
40	9.822688	9.873335	9.949353	10.050647	20
41	9.822830	9.873223	9.949607	10.050393	19
42	9.822972	9.873110	9.949862	10.050138	18
43	9.823114	9.872998	9.950116	10.049884	17
44	9.823255	9.872885	9.950370	10.049630	16
45	9.823397	9.872772	9.950625	10.049375	15
46	9.823538	9.872659	9.950879	10.049121	14
47	9.823680	9.872546	9.951133	10.048867	13
48	9.823821	9.872434	9.951388	10.048612	12
49	9.823962	9.872321	9.951642	10.048358	11
50	9.824104	9.872208	9.951896	10.048104	10
51	9.824245	9.872094	9.952150	10.047850	9
52	9.824386	9.871981	9.952404	10.047575	8
53	9.824527	9.871868	9.952659	10.047341	7
54	9.824667	9.871755	9.952913	10.047087	6
55	9.824808	9.871641	9.953167	10.046833	5
56	9.824949	9.871528	9.953421	10.046579	4
57	9.825090	9.871414	9.953675	10.046325	3
58	9.825230	9.871300	9.953929	10.046071	2
59	9.825370	9.871187	9.954183	10.045817	1
60	9.825511	9.871073	9.954437	10.045562	0
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-sine	Tangent	Co-tang.	
0	9.825511	9.871073	9.954437	10.045562	60
1	9.825651	9.870960	9.954691	10.045308	59
2	9.825791	9.870846	9.954545	10.045054	58
3	9.825931	9.870732	9.955199	10.044800	57
4	9.826071	9.870618	9.955453	10.044546	56
5	9.826211	9.870504	9.955707	10.044292	55
6	9.826351	9.870390	9.955961	10.044038	54
7	9.826491	9.870275	9.956215	10.043784	53
8	9.826631	9.870161	9.956469	10.043531	52
9	9.826770	9.870047	9.956723	10.043276	51
10	9.826910	9.869933	9.956977	10.043023	50
11	9.827049	9.869818	9.957231	10.042769	49
12	9.827189	9.869704	9.957485	10.042515	48
13	9.827328	9.869589	9.957739	10.042261	47
14	9.827467	9.869474	9.957993	10.042007	46
15	9.827606	9.869360	9.958246	10.041753	45
16	9.827745	9.869245	9.958500	10.041500	44
17	9.827884	9.869130	9.958754	10.041246	43
18	9.828023	9.869015	9.959008	10.040992	42
19	9.828162	9.868900	9.959262	10.040738	41
20	9.828301	9.868785	9.959515	10.040485	40
21	9.828439	9.868670	9.959769	10.040231	39
22	9.828578	9.868555	9.960023	10.039977	38
23	9.828716	9.868449	9.960277	10.039723	37
24	9.828855	9.868324	9.960530	10.039469	36
25	9.828993	9.868209	9.960784	10.039916	35
26	9.829131	9.868009	9.961038	10.038962	34
27	9.829269	9.867978	9.961291	10.038708	33
28	9.829407	9.867862	9.961545	10.038455	32
29	9.829545	9.867747	9.961799	10.038201	31
30	9.829683	9.867631	9.962052	10.037947	30
	Co-sine	Sine	Co-tang.	Tangent	M

M	Sine	Co-fine	Tangent	Co-tang.	
30	9.829683	9.867631	9.962052	10.037947	30
31	9.829821	9.867515	9.962306	10.037694	29
32	9.829959	9.867399	9.952560	10.037140	28
33	9.830096	9.867283	9.962813	10.037187	27
34	9.830234	9.867167	9.963067	10.036933	16
35	9.830372	9.867051	9.963320	10.036680	25
36	9.830509	9.866935	9.963574	10.036426	24
37	9.830646	9.866819	9.963827	10.036173	23
38	9.830784	9.866703	9.964081	10.035919	22
39	9.830921	9.866586	9.964335	10.035665	21
40	9.831058	9.866470	9.964588	10.035411	20
41	9.831195	9.866353	9.964842	10.035158	19
42	9.831332	9.866237	9.965095	10.034905	18
43	9.831469	9.866120	9.965348	10.034652	17
44	9.831606	9.866004	9.965602	10.034398	16
45	9.831742	9.865887	9.965855	10.034114	15
46	9.831879	9.865770	9.966109	10.033891	14
47	9.832015	9.865653	9.966262	10.033638	13
48	9.832152	9.865536	9.966616	10.033384	12
49	9.832288	9.865419	9.966869	10.033131	11
50	9.832425	9.865302	9.967122	10.032878	10
51	9.832561	9.865185	9.967376	10.032624	9
52	9.832697	9.865068	9.967629	10.032371	8
53	9.832833	9.864950	9.967883	10.032117	7
54	9.832969	9.864833	9.968136	10.031864	6
55	9.833105	9.864716	9.968389	10.031611	5
56	9.833241	9.864598	9.968643	10.031357	4
57	9.833376	9.864480	9.968896	10.031104	3
58	9.833512	9.864363	9.969149	10.030851	2
59	9.833648	9.864245	9.969403	10.030597	1
60	9.833783	9.864127	9.969656	10.030344	0
	Co-fine	Sine	Co-tang.	Tangent	M

H 4

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.823783	9.864127	9.969656	10.030344	60
1	9.833919	9.864010	9.969909	10.030091	59
2	9.834054	9.863892	9.970162	10.029838	58
3	9.834189	9.863774	9.970416	10.029584	57
4	9.834324	9.863656	9.970669	10.029331	56
5	9.834460	9.863537	9.970922	10.029078	55
6	9.834595	9.863419	9.271175	10.028825	54
7	9.834730	9.863301	9.971428	10.028572	53
8	9.834865	9.863183	9.971682	10.028318	52
9	9.834999	9.863064	9.971935	10.028065	51
10	9.835134	9.862946	9.972188	10.027812	50
11	9.835269	9.862827	9.972441	10.027559	49
12	9.835403	9.862709	9.972694	20.027306	48
13	9.835538	9.862590	9.972948	10.027052	47
14	9.835672	9.862471	9.973201	10.026799	46
15	9.835806	9.862353	9.973454	10.026546	45
16	9.835941	9.862234	9.973707	10.026293	44
17	9.836075	9.862115	9.973960	10.026040	43
18	9.836209	9.861996	9.974213	10.025787	42
19	9.836343	9.861877	9.974466	10.025533	41
20	9.836477	9.861757	9.974719	10.025280	40
21	9.836611	9.861638	9.974973	10.025027	39
22	9.836745	9.861519	9.975226	10.024774	38
23	9.836878	9.861399	9.975479	10.024521	37
24	9.837012	9.861280	9.975732	10.024268	36
25	9.837146	9.861161	9.975985	10.024015	35
26	9.837279	9.861041	9.976238	10.023762	34
27	9.837412	9.860921	9.976491	10.023509	33
28	9.837546	9.860802	9.976744	10.023256	32
29	9.837679	9.860682	9.976997	10.023003	31
30	9.837812	9.860562	9.977250	10.022750	30
	Co-fine	Sine	Co-tang.	Tangent	M

Degree 43.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.837812	9.86056	9.977250	10.022750	30
31	9.837945	9.8604,2	9.977503	10.022497	29
32	9.838078	9.860332	9.977756	10.022244	28
33	9.838211	9.860202	9.978009	10.021991	27
34	9.838344	9.860082	9.978262	10.021738	26
35	9.838477	9.859362	9.978515	10.021485	25
36	9.838609	9.859842	9.978768	10.021232	24
37	9.838742	9.859721	9.979021	10.020979	23
38	9.838875	9.859601	9.979274	10.020726	22
39	9.839007	9.859480	9.979527	10.020473	21
40	9.839140	9.859262	9.979780	10.020220	20
41	9.839272	9.859239	9.980033	10.019967	19
42	9.839404	9.859118	9.980253	10.019714	18
43	9.839536	9.858998	9.980538	10.019461	17
44	9.839668	9.858877	9.980791	10.019209	16
45	9.839800	9.858756	9.981044	10.018956	15
46	9.839932	9.858635	9.981297	10.018703	14
47	9.840064	9.858514	9.981550	10.018450	13
48	9.840196	9.858393	9.981803	10.018197	12
49	9.840328	9.858272	9.982056	10.017944	11
50	9.840459	9.858150	9.982309	10.017691	10
51	9.840591	9.858029	9.982562	10.017438	9
52	9.840722	9.857909	9.982814	10.017185	8
53	9.840854	9.857788	9.983067	10.016932	7
54	9.840985	9.857666	9.983320	10.016680	6
55	9.841116	9.857545	9.983573	10.016427	5
56	9.841247	9.857421	9.983826	10.016174	4
57	9.841378	9.857300	9.984079	10.015921	3
58	9.841509	9.857178	9.984331	10.015668	2
59	9.841640	9.857056	9.984584	10.015416	1
60	9.841771	9.856934	9.984837	10.015163	0
	Co-sine	Sine	Co-tang.	Tangent	M

Degree 46.

Degree 44.

M	Sine	Co-fine	Tangent	Co-tang.	
0	9.841771	9.856934	9.984837	10.015162	60
1	9.841902	9.856812	9.985090	10.014910	59
2	9.842033	9.856690	9.985343	10.014657	58
3	9.842153	9.856568	9.985596	10.014404	57
4	9.842294	9.856445	9.985848	10.014151	56
5	9.842424	9.856323	9.986101	10.013899	55
6	9.842555	9.856201	9.986354	10.013646	54
7	9.842685	9.856078	9.986627	10.013393	53
8	9.842815	9.855956	9.986859	10.013140	52
9	9.842945	9.855833	9.987112	10.012888	51
10	9.843076	9.855710	9.987365	10.012635	50
11	9.843206	9.855588	9.987618	10.012382	49
12	9.843336	9.855465	9.987871	10.012129	48
13	9.843465	9.855342	9.988123	10.011877	47
14	9.843595	9.855219	9.988376	10.011624	46
15	9.843725	9.855096	9.988629	10.011371	45
16	9.843855	9.854973	9.988882	10.011118	44
17	9.843984	9.854850	9.989134	10.010866	43
18	9.844114	9.854727	9.989387	10.010613	42
19	9.844243	9.854603	9.989640	10.010360	41
20	9.844372	9.854480	9.989893	10.010107	40
21	9.844502	9.854356	9.990145	10.009855	39
22	9.844631	9.854233	9.990398	10.009602	38
23	9.844760	9.854109	9.990651	10.009349	37
24	9.844889	9.853986	9.990903	10.009096	36
25	9.845018	9.853862	9.991156	10.008844	35
26	9.845147	9.853738	9.991409	10.008591	34
27	9.845276	9.853614	9.991662	10.008338	33
28	9.845404	9.853490	9.991914	10.008086	32
29	9.845533	9.853366	9.992167	10.007833	31
30	9.845662	9.853242	9.992420	10.007580	30
	Co-fine	Sine	Co-tang.	Tangent	M

Degree 45.

M	Sine	Co-sine	Tangent	Co-tang.	
30	9.845662	9.853242	9.992420	10.007580	30
31	9.845790	9.853118	9.992672	10.007328	29
32	9.845919	9.852994	9.992925	10.007075	28
33	9.846047	9.852869	9.993178	10.006822	27
34	9.846175	9.852745	9.993430	10.006569	26
35	9.846304	9.852620	9.993683	10.006317	25
36	9.846432	9.852496	9.993936	10.006064	24
37	9.846560	9.852371	9.994189	10.005811	23
38	9.846688	9.852246	9.994441	10.005559	22
39	9.846816	9.852122	9.994694	10.005306	21
40	9.846944	9.851997	9.994947	10.005053	20
41	9.847071	9.851872	9.995199	10.004801	19
42	9.847199	9.851747	9.995452	10.004548	18
43	9.847327	9.851622	9.995705	10.004295	17
44	9.847454	9.851497	9.995957	10.004043	16
45	9.847582	9.851372	9.996210	10.003790	15
46	9.847709	9.851246	9.996463	10.003537	14
47	9.847836	9.851121	9.996715	10.003285	13
48	9.847964	9.850996	9.996968	10.003032	12
49	9.848091	9.850870	9.997220	10.002779	11
50	9.848218	9.850745	9.997473	10.002527	10
51	9.848345	9.850619	9.997726	10.002274	9
52	9.848472	9.850493	9.997979	10.002021	8
53	9.848599	9.850367	9.998231	10.001769	7
54	9.848726	9.850242	9.998484	10.001516	6
55	9.848852	9.850116	9.998737	10.001263	5
56	9.848979	9.849990	9.998989	10.001011	4
57	9.849106	9.849864	9.999242	10.000758	3
58	9.849232	9.849737	9.999495	10.000505	2
59	9.849359	9.849611	9.999747	10.000253	1
60	9.849485	9.849485	10.000000	10.000000	0
	Co-sine	Sine	Co-tang.	Tangent	M

A most useful Table, whereby the true time of the Night may be known to a minute, without knowing the Meridian, height, or distance of the *.

Stars names that never set, and will be under the Pole Star.	right asc. in time under the Pole *	d. in t. bet. the pole * & pole	Azimuth under Pole *	From Meri.	Magnitude
	h ' ''	' ''	o ' ''		
1 Cassiopeia's hip - -	12,38,01	00, 07	00,01,00	E	3
2 ---- her knee ---	13 08,33	03, 25	00,30,30	E	3
3 In Perseus side--	15,15,39	14, 40	02,21,30	E	2
4 Great Bears lip	20,13,11	09, 19	01,43,20	E	4
5 In his left knee	21,16,04	11, 59	01,51,30	E	3
6 Lower leader	22,53,21	11, 08	01,33,40	E	2
7 Upper i'th'wain	22,55,42	12, 07	01,29,20	E	2
8 The lower in □	23,42,52	05, 26	00,57,00	E	2
9 The upper ---	00,21,33	02, 05	00,35,20	F	2
10 Rump or Aliot	00,39,18	00, 18	00,02,30	W	2
11 Last but one tayl	01,07,09	03, 40	00,25,00	W	2
12 Last of the tayl	01,29,05	05, 40	00,55,00	W	2
13 Last turn of Dr.	01,48,12	10, 52	01,14,40	W	2
14 Upper guard l.B.	02,24,32	26, 06	02,01,50	W	2
15 Lower of lit. B.	02,58,42	26, 38	02,22,12	W	2
16 Br. * Drag.hea	05,25,26	43, 17	03,42 44	W	2
17 Upp. turn of D	05,38,11	34, 54	03,51,20	W	2
18 Cepheus left sho.	08,43,06	27, 20	03,10,20	W	2
19 In his Girdle ---	08,55,04	24, 43	03,04,40	W	3
20 Right knee -----	11,10,02	17, 3	01,21,40	W	3
21 Cassiopea's chair	11,41,37	10, 21	00,48,20	W	3
22 In her breast ---	12,20,56	01, 32	00,15,20	W	3

♈ H	♎ H	Com. parts ′ ″	diff. ″	♉ H	♏ H	Com. parts ′ ″	diff. ″
1	0	11 3.43	222	1	13	55.25	230
2	0	12 7.20	220	1	13	59.15	231
3	0	12 11.10	220	2	14	3.06	231
4	0	12 14.40	210	2	14	6.57	232
5	0	12 18.20	210	2	14	10.49	232
			220				233
6	0	12 22.00	220	2	14	14.42	233
7	0	12 25.41	221	2	14	88.35	234
8	0	12 29.22	221	2	14	22.29	234
9	0	12 33.03	221	2	14	26.23	235
10	0	12 36.44	221	2	14	30.18	235
			221				236
11	0	12 40.25	222	2	14	34.14	237
12	0	12 44.07	222	2	14	38.11	237
13	0	12 47.49	222	2	14	42.08	238
14	0	12 51.31	222	2	14	46.96	239
15	0	12 55.13	222	2	14	50.05	239
			223				239
16	0	12 58.56	223	2	14	54.04	241
17	1	13 2.39	223	2	14	58.05	241
18	1	13 6.22	224	3	15	2.06	241
19	1	13 10.06	224	3	15	6.07	243
20	1	13 13.50	224	3	15	10.10	243
			224				244
21	1	13 17.34	225	3	15	14.13	244
22	1	13 21.19	225	3	15	18.17	244
23	1	13 25.04	225	3	15	22.21	245
24	1	13 28.50	226	3	15	26.26	246
25	1	13 32.36	226	3	15	30.32	247
			227				247
25	1	13 36.23	227	3	15	34.39	248
27	1	13 40.10	227	3	15	38.47	248
28	1	13 43.58	228	3	15	42.55	249
29	1	13 47.47	229	3	15	47.04	249
30	1	13 51.36	229	3	15	51.13	249

	♊ H	♐ H	Com. parts ' "	diff. "	♋	♑	Com. parts ' "	diff. "
1	3	15	55.24	251	6	18	4.22	262
2	3	15	59.35	252	6	18	8.43	262
3	4	16	3.46	250	6	18	13.05	262
4	4	16	7.58	253	6	18	17.27	261
5	4	16	12.11	253	6	18	21.48	261
6	4	16	16.25	254	6	18	26.39	261
7	4	16	20.39	255	6	18	30.30	261
8	4	16	24.53	255	6	18	34.51	260
9	4	16	29.09	256	6	18	39.11	260
10	4	16	33.24	256	6	18	43.31	260
11	4	16	37.41	257	6	18	47.51	260
12	4	16	41.57	257	6	18	52.11	260
13	4	16	46.15	258	6	18	56.31	259
14	4	16	50.32	258	7	19	0.50	259
15	4	16	54.51	259	7	19	5.09	258
16	4	16	59.09	259	7	19	9.27	258
17	5	17	3.28	260	7	19	13.45	257
18	5	17	7.48	260	7	19	18.02	257
19	5	17	12.08	260	7	19	22.19	256
20	5	17	16.28	260	7	19	26.35	256
21	5	17	20.48	260	7	19	30.51	255
22	5	17	25.09	261	7	19	35.06	255
23	5	17	29.30	261	7	19	39.21	254
24	5	17	33.51	261	7	19	43.35	253
25	5	17	38.12	261	7	19	47.48	253
26	5	17	42.33	262	7	19	52.01	252
27	5	17	46.55	262	7	19	56.13	252
28	5	17	51.17	262	8	20	00.25	251
29	5	17	55.38	262	8	20	4.36	250
30	6	18	0.00	262	8	20	8.46	250

	♌ H	♒ H	Com. parts ' "	diff "	♍ H	♓ H	Com. parts ' "	diff "
1	8	20	12.55	249	10	22	12.13	228
2	8	20	17.04	248	10	22	16.01	228
3	8	20	21.12	248	10	22	19.49	227
4	8	20	25.20	247	10	22	23.36	227
5	8	20	29.27	246	10	22	27.23	226
6	8	20	33.33	245	10	22	31.09	226
7	8	20	37.38	244	10	22	34.55	225
8	8	20	41.42	244	10	22	38.40	225
9	8	20	45.46	244	10	22	42.25	225
10	8	20	49.50	244	10	22	46.10	225
				243				224
11	8	20	53.53	242	10	22	49.54	224
12	8	20	57.55	240	10	22	53.38	223
13	9	21	1.55	240	10	22	57.21	223
14	9	21	5.55	239	11	23	1.4	223
15	9	21	9.54	239	11	23	4.17	223
				239				222
16	9	21	13.53	238	11	23	8.29	222
17	9	21	17.51	237	11	23	12.11	222
18	9	21	21.48	237	11	23	15.53	221
19	9	21	25.45	237	11	23	19.34	221
20	9	21	29.41	236	11	23	23.15	221
				235				221
21	9	21	33.36	234	11	23	26.56	221
22	9	21	37.30	234	11	23	30.37	221
23	9	21	41.24	234	11	23	34.18	221
24	9	21	45.17	233	11	23	37.59	221
25	9	21	49.10	233	11	23	41.39	220
				232				220
26	9	21	53.02	231	11	23	45.19	220
27	9	21	56.53	231	11	23	48.59	220
28	10	22	0.44	231	11	23	52.39	220
29	10	22	4.34	230	11	23	56.20	221
30	10	22	8.24	230	12	24	00.00	220

Mag.	Names of the Stars.	Longitude	Latitude
2	In the head of *Andr.*	♈ 09.52.00	25.42.10 N
2	In her Girdle ———	♈ 25.54.00	25.58.30 N
2	In her Souther foot	♉ 09.44.50	27.47.10 N
1	In *Aquar.* Fo nahant	♒ 29. 9.43	20.59.43 S
3	In his right shoulder	♒ 28.55.03	10.42 15 N
3	In his left shoulder	♒ 18.56.33	08.42 15 N
3	In his left hand ———	♒ 11.56.33	04.50.15 N
3	Br. ✳ in *Aqui. vul.*	♑ 27.15.23	29.20.40 N
4	1. Horn ♈ ———	♈ 28.42.33	07.08.00 N
4	2. Horn of ♈	♈ 29.28.33	08.28.30 N
3	Bright ✳ in *Aries*	♉ 03.11.32	09.56.30 N
1	*Capella*	♊ 17.23.08	22.51.45 N
1	In his right shoulder	♊ 25.28.28	21.25._0 N
1	*Bootes, Arcturus*	♎ 19.47.13	31.00.40 N
3	In his left shoulder	♎ 14.13.33	49.51.42 N
neb	*Cancer, Præsepe* ———	♋ 02.51.29	01.14.30 N
4	*Canc.* the Nor. *Asell*	♋ 03.01.59	03.08.30 N
4	The Southern *Asell*	♋ 04 12.59	00.03.30 N
1	The G. dog ✳ *Sirius*	♋ 09 47.53	39.22.05 S
1	The L. d. ✳ *Procion*	♋ 21.23.22	15.37.10 S
3	*Capric.* the fore horn	♑ 29.27.32	07.03 11 N
3	the lower horn	♑ 29.40.33	04.42.10 N
3	former in the tayl	♑ 17.23.33	02.24.50 S
3	later in the tayl	♑ 19.09.33	02.27.50 S
2	*Caff.* br. ✳ i' th' chair	♈ 00.38.53	51.17.00 N
3	Brig. ✳ in her breast	♉ 03.22.33	46.36.50 N
3	In the *bend* of her *hip*	♉ 09._2.33	48.47.50 N
3	In her knee	♉ 13.26.03	46.23 50 N
3	*Cepheus* in his Girdle	♈ 01.19.33	71.08.30 N
2	*Cete* the Whale's jaw	♉ 09.52.23	12.36.50 N
3	In the belly North	♈ 17.31.21	20.17.20 S
3	The Nor. in the tayl	♓ 26.29.53	09.58.10 N
2	The Southern ———	♓ 28.02.53	20.43.40 N
2	Nor. Cr. the bright ✳	♏ 07.45.36	44.25.20 N

r. asc. in d.	w. af. in ti,	Declination	dif. r.a.	dif. dec. 10 y
o ' "	h ' "	o ' "	h ' "	' "
357.58.44	23.51.55	27.20.38 N	0.31	03.24 A
12.54.44	0.51.39	33.56. 4 N	0.33	03.18 A
26.04.03	1.44.16	40.45. 0 N	0.35	02.00 A
339.54.00	22.39.36	81.14.10 S	0.34	03.00 S
227.20.55	21.49.24	1.49.32 S	0.22	02.54 A
318.39.42	21.14.39	6.53.58 S	0.32	0 .36 S
307.30.42	20.30.03	10.37 32 S	0.34	01.54 S
293.47.25	19.35. 9	8. 3.56 N	0.1	01.18 A
24.00.25	1.36. 2	17.42.12 N	0.33	03.07 A
24.13.39	1.36.55	19.12.42 N	0.33	02.51 A
27.18.58	1.49.16	21.55.30 N	0.34	03.00 A
73.09.28	4.52.36	45.38.00 N	0.33	01.00 A
84.06.06	5.36 24	44.50.40 N	0.47	00.25 A
210.18.50	14. 1.15	20.53.56 N	0.28	02.57 S
214.50 09	14.19.21	39.10.36 N	0.25	02.41 S
125.28.26	8.21.54	20.46.5 N	0.35	01.54 S
126.08.00	8.24.32	22.35.00 N	0.36	01.00 S
126.36.32	8.26.26	19.19.00 N	0.35	01.00 S
97.43.42	6.30.55	16.17.18 S	0.27	00.24 A
112.38.32	7.22.34	6. 1.36 N	0.32	01.12 S
300.07.34	20. 0.30	13.25.18 S	0.34	01.36 S
300.50.05	20. 3.20	15.41.26 S	0.35	01.42 S
320.39.17	21.22.37	17.59.33 S	0 34	02.36 S
322.26.30	21.29.46	17.27 46 S	0 34	02.42 S
357.59.33	23.51.58	57.25.28 N	0.30	03.24 A
5.39.36	0.22.38	54.48.28 N	0.33	03.24 A
9.28.24	0.37.54	59. 0.48 N	0.34	03.24 A
16.17.00	1.05. 8	58 33.46 N	02.38	02.18 A
321. 2.06	21.24. 8	69.11.56 N	8 39	02.36 A
41.23.07	2 45.32	2.48 50 N	0 30	02.30 A
23.57.00	1.35.48	11.51.02 N	0.30	03.05 S
0.48.36	0. 3.14	10.31.50 S	0 31	03.30 S
6.59.44	0.27.59	19.42.32 S	.31	03.24 S
230.26.00	15.21.44	27.49.32 N	0.26	02.06 S

Left margin (vertical):

A Table of the Longitude, Latitude, Right Ascension, Declination of 109 of the most Notable Stars for Anno 1: 80. with the Difference for every Ten Years.

Mag	Names of the Stars	Longitude	Latitude
		° ′ ″	° ′ ″
3	In the Swans bill -	♈ 26.48.37	49.03.00 N
3	In her brest - - -	♒ 20.28.37	57.10.20 N
2	In her tayle - - -	♒ 00.58.18	59.57 20 N
2	In her upper wing -	♒ 11.57.53	64.25.50 N
3	In her lower - - -	♒ 23.14.22	49.27.00 N
3	Bright ✶ in Draco	♐ 23.29.13	75.01.10 N
2	Gemini's head of Ca.	♋ 15.44.53	10.02.50 N
2	Gem. head of Pollux	♋ 18.47.59	06.38.30 N
2	In the bright foot	♋ 04.54.53	06.48.00 S
3	Hercules his Head -	♐ 11.41.13	37.22.15 N
2	In his right shoulder	♏ 26.37.43	42.47.15 N
2	In his left shoulder	♏ 10.29.13	47.46.15 N
1	Hydra's Heart - -	♌ 22.49.43	22.23.50 S
1	Lyons Heart - - -	♌ 25.21.38	00.26.20 N
3	Lyons Tayle - - -	♍ 17.09.53	12.16.20 N
2	Ly. br. ✶ in his crest	♍ 25.01.15	08.45.40 N
2	Ly. br. ✶ in his loin	♍ 06.50.38	14.18.30 N
3	Ly. i'th' top of's neck	♌ 22.59.53	11.48.40 N
3	Ly. below in his neck	♌ 23.22.23	04.50.40 N
3	In the back o'th bare	♎ 15.12.13	43.55.50 S
2	Northern Ballance	♏ 14.55.23	08.33.30 N
2	Southern Ballance	♏ 10.39.33	00.25.10 N
1	Bright star i'th' harp	♈ 10.49.23	61.47.00 N
3	i'th' head of Ophiu	♐ 18.00.13	35.56 15 N
3	In his left hand	♏ 27.54 43	17.18.20 N
3	In his right knee - -	♐ 13.34.12	07.17.20 N
3	In his left knee - -	♐ 04.49.13	11.29.20 N
1	In his right shoulder	♐ 20.55.23	28.00.20 N
4	Ori.i'th' top of his h.	♊ 19.17.53	13.25.30 S
2	Orions right shoulder	♊ 24.19.41	16.06.15 S
2	In his left shoulder	♊ 16.29.53	16.52.30 S
1	Orions Foot Rigel	♊ 12.19.0.	31.10 10 S
2	First of his belt - -	♊ 17.52.23	23.36.40 S
2	Second of his belt	♊ 18.56.48	24.34.10 S

r.asc. in d.	r.as in ti.	Declination	dif.r.a.	dif.dec. 10 y
o " "	h ' "	o " "	h' "	" "
289.27.36	19.17.50	27.20.28 N	0.24	01.06 A
302.45.10	20.11.01	39.16.39 N	0.21	01.48 A
307.37.06	20.30.28	44.10.46 N	0.20	02.03 A
293 51.26	19.35.26	44.23.33 N	0.29	01.24 A
308.17.10	20.33.09	32.47.12 N	0.24	02.06 A
267.18.20	17.49.13	51.29.26 N	0.14	01.2 8
108.19.58	07.14.00	32.32.38 N	0.41	01.06 S
111.25.18	07.25.41	28.45.26 N	0.38	01.12 S
094.45.56	06.19.04	16.37.56 N	0.35	00.12 S
255.01.52	17.00.07	14.48.44 N	0.27	00.18 S
244.06.35	16.16.26	22.15.40 N	0.26	01.00 S
255.26.19	17.01.45	25.17.24 N	0.21	00.48 S
137.57.22	09.11.49	07.16 30 S	0.30	02.30 A
147.47.45	09.51.11	13.30.58 N	0.33	02.51 S
173.09.46	11.32.39	16.20.52 N	0.31	03.24 S
150.31.41	10.02.07	21.26.48 N	0.34	02.54 S
164.14.55	10.57.00	22.14.32 N	0.35	03.24 S
149.41.16	09.58.45	24.59.42 N	0.35	01.54 S
147.30.16	09.50.01	18.19.09 N	0.35	01.48 S
078.38.30	05.14.34	21.00.13 N	0.26	00.41 S
224.59.02	14.59.56	08.09.58 S	0.32	00.24 A
218.21.44	14.33.27	14.39.54 S	0.33	00.42 A
276.29.32	18.25.58	38.31.28 N	0.20	00.24 A
260.01.26	17.20.06	12.51.46 N	0.28	00.42 S
239.31.01	15.58.04	02. 9.16 S	0.33	01.48 A
252.55.46	16.51.43	15.14.30 S	0.30	01.30 A
244.55.01	16.19.40	19.50.30 S	0.33	01.00 A
261.54.02	17.27.36	04.43.46 N	0.33	00.30 S
079.24.45	05.17.39	09.42.14 N	0.33	00.42 A
084.26.40	05.37.47	07.17.32 N	0.33	00.24 A
077.00.52	05.08.03	06.01.26 N	0.31	00.48 A
074.47.44	04.59.11	08.35.36 S	0.30	00.57 S
078.54.24	05.15.37	00.34.14 S	0.31	00.42 S
079.57.27	05.19.50	01.26.58 S	1.31	00.36 S

A Table of the Longitudes, Latitudes, Right Ascension, Declination of 100 of the most Notable Stars for Anno 1680, with the Difference for every Ten Years.

Dec	Names of the Stars	Longitude ° ' "	Latitude ° ' "
2	The 3d in Orion's belt	♊ 20.06.03	25.21.10 S
2	Pegasus in his mouth	♒ 27 28.17	22.06.20 N
3	In his thigh, sheast	♓ 24.57.13	31.08.20 N
2	Bright ✶ in the wing	♓ 19.02.13	19.24.50 N
3	Br. i' th' lower w.	♈ 04.43.13	12.37.10 N
2	Perseus in his side	♉ 27.17.01	30.05.50 N
2	Caput Medusæ	♉ 21.49.03	22.22.44 N
4	Southern fish occiput	♓ 16.56.05	07.17.00 N
2	Bright ✶ betwixt ♓	♈ 24.53.05	09.04.00 S
2	Sagittar. in his head	♑ 09.05.33	01.45.10 N
3	Scorpion's heart	♐ 05.18.33	04.26.30 S
2	In his forehead north	♏ 28.40.03	01.06.55 N
3	In his foreh. middle	♏ 28.03.43	01.52.40 S
2	In his forehead South	♏ 28.28.53	05.20.40 S
2	Serpents neck br. ✶	♏ 17.33.53	25.33.50 N
2	Bulls eye South	♊ 05.18.36	05.30.50 S
2	Bulls Northern eye	♊ 03.59.06	02.36.10 N
2	The lowest of Hiades	♊ 01.17.08	05.46.20 S
2	His Northern horn	♊ 18.05.53	05.20.30 N
2	His Southern horn	♊ 20.18.53	02.13.30 S
3	Brightest of the 7 ✶	♉ 25.37.42	03.59.00 N
2	Virgin Spike	♎ 19.22.53	01.59.30 S
2	Br. ✶ in her Girdle	♍ 07.01.53	08.49.20 N
2	Vindimiatrix	♎ 05.28.23	16.15.00 N
2	Great Bears shoulder	♌ 10.41.32	49.40.10 N
2	Next under it	♌ 14.51.03	45.05.40 N
2	Br. ✶ hinder thigh	♌ 25.57.33	47.08.40 N
3	Bright ✶ in his back	♌ 26.33.03	51.37.10 N
2	In his, Rump Aliot	♍ 04.19.33	54.17.45 N
2	Middle in the tayl	♍ 11.04.59	56.21.10 N
2	Last in the tayl	♍ 22.20.03	54.24.10 N
2	The Pole Star	♋ 24.09.53	65.59.50 N
2	Little Bears shoulder	♌ 08.28.12	72.48.40 N

r.asc. in d	r.as.in ti.	Declination	dif.r.a.	dif.dec. 10 y.
o " "	h " "	o " "	h "	" "
081.03.12	05.14.13	02.09.20 S	0.30	00.30 S
322.12.00	21.28.48	08.27.02 N	0.31	02.36 A
342.06.12	22.48.25	26.22.09 N	0.29	03.09 A
342.13.08	22.48.52	13.29.29 N	0.30	03.09 A
359.12.12	23.56.49	13.16.08 N	0.20	03.24 A
045.04.42	03.00.19	48.39.42 N	0.35	02.36 A
041.53.18	02.47.33	39.41.30 N	0.39	02.30 A
345.08.40	23.00.35	01.33.26 N	0.39	03.18 A
026.22.38	01.45.30	01.13.00 N	0.32	03.00 A
279.47.37	18.39.10	21.24.24 S	0.47	00.48 S
242.29.04	16.09.56	25.36.42 S	0.37	01.36 A
236.40.51	15.46.43	18.49.48 S	0.35	01.54 A
235.19.3	15.43.06	21.37.40 S	0.36	02.00 A
234.8.31	15.39.54	25.05.42 S	0.39	02.06 A
32.09.00	15.28.36	07.20.24 N	0.30	02.06 S
064.24.16	04.17.37	15.50.10 N	0.34	01.30 A
062.26.48	04.09.47	18.33.52 N	0.34	01.42 A
060.22.35	04.01.30	14.49.02 N	0.34	01.42 A
076.31.54	05.06.07	28.20.38 N	0.39	00.48 A
079.37.18	05.18.29	20.57.22 N	0.36	00.32 A
052.09.49	03.28.39	23.03 36 N	0.35	02.06 A
197.06.57	13 08.28	09.27.00 S	0.31	03.15 A
189.54.46	12 39.39	05.09.42 N	0.31	05.24 S
191.26.56	12.46.27	12.41.34 N	0.31	93.18 S
160.56.52	10.43.47	63.28.26 N	0 40	03.12 S
160.32.55	10.42.11	38.05.26 N	0.39	03.12 S
174.06.58	11.36.27	55.30.06 N	0.33	03.12 S
179.52.01	11.59.28	58.17.06 N	0.32	03.12 S
189.54.08	12.39.36	57.43 24 N	0.27	03.18 S
197.42 26	13.10.50	56.37.16 N	0.25	03.12 S
203.41.25	13.34 46	50.57.08 N	0.24	03.06 S
009.14.10	00.36.57	87.36.03 N	1.16	02.24 A
222.40.05	14.50.40	75.38.00 N	0.01	00.15 A

	1 farthing	2 farthings	3 farthings
	li. sh. d. q.	li. sh. d. q.	li. sh. d. q.
1	1	2	3
2	2	1.0	1,2
3	3	1,2	2,1
4	1.0	2,0	3.0
5	1,1	2,2	3,3
6	1,2	3.0	4,2
7	1,3	3,2	5,1
8	2,0	4.0	6,0
9	2,1	4,2	6,3
10	2,2	5.0	7,2
20	5.0	10.0	1, 3,0
30	7,2	1, 3,0	1,10,2
40	10,0	1, 8,0	2, 6,0
50	1, 0,2	2, 1,0	3, 1,2
60	1, 0,3	2, 6,0	3, 9,0
70	1, 5,2	2,11,0	4, 4,2
80	1, 8,0	3, 4,0	5, 0,0
90	1,10,2	3, 9,0	5, 7,2
100	2, 1,0	4, 2,0	6, 3,0
200	4, 2,0	8, 4,0	12, 6,0
300	6, 3,0	12, 6,0	18, 9,0
400	8, 4,0	16, 8,0	1, 5, 0,0
500	10, 5,0	1, 0,10,0	1,11, 3,0
600	12, 6,0	1, 5, 0,0	1,17, 6,0
700	14, 7,0	1, 9, 2,0	2, 3, 9,0
800	16, 8,0	1,13, 4,0	2,10, 0,0
900	18, 9,0	1,17, 6,0	2,16, 3,0
1000	1, 0,10,0	2, 1, 8,0	3, 2, 6,0
2000	2, 1, 8,0	4, 3, 4,0	6, 5, 0,0
5000	5, 4, 2,0	10, 8, 4,0	15,12, 6,0
10000	10, 8, 4,0	20,16, 8,0	31, 5, 0,0

	1 penny			2 pence			3 pence			4 pence		
	li.	sh.	d.	li.	sh.	d.	li.	sh.	d.	li.	sh.	d.
1			1			2			3			4
2			2			4			6			8
3			3			6			9		1.	0
4			4			8		1.	0		1.	4
5			5			10		1.	3		1.	8
6			6		1.	0		1.	6		2.	0
7			7		1.	2		1.	9		2.	4
8			8		1.	4		2.	0		2.	8
9			9		1.	6		2.	3		3.	0
10			10		1.	8		2.	6		3.	4
20		1.	8		3.	4		5.	0		6.	8
30		2.	6		5.	0		7.	6		10.	0
40		3.	4		6.	8		10.	0		13.	4
50		4.	2		8.	4		12.	6		16.	8
60		5.	0		10.	0		15.	0	1.	0.	0
70		5.	10		11.	8		17.	6	1.	3.	4
80		6.	8		13.	4	1.	0.	0	1.	6.	8
90		7.	6		15.	0	1.	2.	6	1.	10.	0
100		8.	4		16.	8	1.	5.	0	1.	13.	4
200		16.	8	1.	13.	4	2.	10.	0	3.	6.	8
300	1.	5.	0	2.	10.	0	3.	15.	0	5.	0.	0
400	1.	13.	4	3.	6.	8	5.	0.	0	6.	13.	4
500	2.	1.	8	4.	3.	4	6.	5.	0	8.	6.	8
600	2.	10.	0	5.	0.	0	7.	10.	0	10.	0.	0
700	2.	18.	4	5.	16.	8	08.	15.	0	11.	13.	4
800	3.	6.	8	6.	13.	4	10.	0.	0	13.	6.	8
900	3.	15.	0	7.	10.	0	11.	5.	0	15.	0.	0
1000	4.	3.	4	8.	6.	8	12.	10.	0	16.	13.	4
2000	8.	6.	8	16.	13.	4	25.	0.	0	33.	6.	8
5000	20.	16.	8	41.	13.	4	62.	10.	0	83.	6.	8
10000	41.	13.	4	83.	6.	8	125.	0.	0	166.	13	.

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A Table of Accounts

	5 pence	6 pence	7 pence	8 pence
	li. sh. d.	li. sh. d.	li. sh. d.	li. sh. d.
1	5	6	7	8
2	10	1. 0	1. 2	1. 4
3	1. 3	1. 6	1. 9	2. 0
4	1. 8	2. 0	2. 4	2. 8
5	2. 1	2. 6	2.11	3. 4
6	2. 6	3. 0	3. 6	4. 0
7	2.11	3. 6	4. 1	4. 8
8	3. 4	4. 0	4. 8	5. 4
9	3. 9	4. 6	5. 3	6. 0
10	4. 2	5. 0	5.10	6. 8
20	8. 4	10. 0	11. 8	13. 4
30	12. 6	15. 0	17. 6	1. 0. 0
40	16. 8	1. 0. 0	1. 3. 4	1. 6. 8
50	1. 0.10	1. 5. 0	1. 9. 2	1.13. 4
60	1. 5. 0	1.10. 0	1.12. 0	2. 0. 0
70	1. 9. 2	1.15. 0	2. 0.10	2. 6. 8
80	1.13. 4	2. 0. 0	2. 6. 8	2.13. 4
90	1.17. 6	2. 5. 0	2.12. 6	3. 0. 0
100	2. 1. 8	2.10. 0	2.18. 4	3. 6. 8
200	4. 3. 4	5. 0. 0	5.16. 8	6.13. 4
300	6. 5. 0	7.10. 0	8.15. 0	10. 0. 0
400	8. 6. 8	10. 0. 0	11.13. 4	13. 6. 8
500	10. 8. 4	12.10. 0	14.11. 8	16.13. 4
600	12.10. 0	15. 0. 0	17.10. 0	20. 0. 0
700	14.11. 8	17.10. 0	20. 8. 4	23. 6. 8
800	16.13. 4	20. 0. 0	23. 6. 8	26.13. 4
900	18.15. 0	22.10. 0	26. 5. 0	30. 0. 0
1000	20.16. 8	25. 0. 0	29. 3. 4	33. 6. 8
2000	41.13. 4	50. 0. 0	58. 6. 8	66.13. 4
5000	104. 3. 4	125. 0. 0	145.16. 8	166.13. 4
10000	208. 6. 8	250. 0. 0	291.13. 4	333. 6. 8

	9 pence	10 pence	11 pence	12 pence
	li. sh. d.	li. sh. d.	li. sh. d.	li. sh. d.
1	9	10	11	1. 0
2	1. 6	1. 8	1.10	2. 0
3	2. 3	2. 6	2. 9	3. 0
4	3. 0	3. 4	3. 8	4. 0
5	3. 9	4. 2	4. 7	5. 0
6	4. 6	5. 0	5. 6	6. 0
7	5. 3	5.10	6. 5	7. 0
8	6. 0	6. 8	7. 4	8. 0
9	6. 9	7. 6	8. 3	9. 0
10	7. 6	8. 4	9. 2	10. 0
20	15. 0	16. 8	18. 4	1. 0. 0
30	1. 2. 6	1. 5. 0	1. 7. 6	1.10. 0
40	1.10. 0	1.13. 4	1.16. 8	2. 0. 0
50	1.17. 6	2. 1. 8	2. 5.10	2.10. 0
60	2. 5. 0	2.10. 0	2.15. 0	3. 0. 0
70	2.12. 6	2.18. 4	3. 4. 2	3.10. 0
80	3. 0. 0	3. 6. 8	3.13. 4	4. 0. 0
90	3. 7. 6	3.15. 0	4. 2. 6	4.10. 0
100	3.15. 0	4. 3. 4	4.11. 8	5. 0. 0
200	7.10. 0	8. 6. 8	9. 3. 4	10. 0. 0
300	11. 5. 0	12.10. 0	13.15. 0	15. 0. 0
400	15. 0. 0	16.13. 4	18. 6. 8	20. 0. 0
500	18.15. 0	20.16. 8	22.18. 4	25. 0. 0
600	22.10. 0	25. 0. 0	27.10. 0	30. 0. 0
700	26. 5. 0	29. 3. 4	32. 1. 8	35. 0. 0
800	30. 0. 0	33. 6. 8	36.13. 4	40. 0. 0
900	33.15. 0	37.10. 0	41. 5. 0	45. 0. 0
1000	37.10. 0	41.13. 4	45.16. 8	50. 0. 0
2000	75. 0. 0	83. 6. 8	91.13. 4	100. 0. 0
5000	187.10. 0	208. 6. 8	229. 3. 4	250. 0. 0
10000	375. 0. 0	415.13. 4	458. 6. 8	500. 0. 0

Forreign *Weights* and *Measures*, careful-
ly compared with the English.

	English Foot, into 10000. equal parts.	English Foot, into ine, and tenth parts of an inch.	The pound A-verdupois into 100 parts.
London Foot - -	1000	0.12. 0	100
France.			
Paris, the Royal Foot	1. 068	1.00. 8	0. 93
Lyon Ell - -	3. 976	3.11. 7	1. 09
Boloyn Ell - -	3. 76	7.00. 8	0. 89
The 17 Provinces.			
Amsterdam Foot - - -	. 942	0.11. 3	0. 93
Ell	2. 269	2.03. 2	
Antwerp Foot - -	. 946	0.11. 3	0. 98
Ell	2. 273	2.03. 3	
Brill Foot	1. 103	1.01. 2	
Dort Foot	1. 184	1.02. 2	
Rynland or Leyden Foot	1. 033	1.00. 4	0. 96
Ell	2. 260	2.03. 1	
Lorain Foot -	. 998	.11. 4	0. 98
Mechelin Foot -	. 919	.11. 0	0. 98
Middleburg Foot	. 991	.11. 9	0. 98

Germany.	Thous par s	F. I. D	Aver. 1C0 p.
Strasbourgh Foot - -	.920	0.11.0	C.93
Bremen Foot -	.964	0.11.6	0.94
Cologn Foot -	.954	0.11.4	0.97
Frankford ad Me- nam Foot	.948	.11.4	0 93
Ell	1.826	1. 9.9	
Hambrough Ell -	1.925	1.10.8	0.95
Leipsig Ell -	2.260	2. 3.1	1.17
Lubick Ell -	1.903	1. 9.8	
Noremburg -	1.006	1.00.1	0.94
Ell	2.227	2. 3.3	
Bavaria -	.954	C.11.4	
Vienna -	1.053	1.00.6	0.83
Spain and *Portu.*			
Spanish Palm, or the Palm of Castile.	.751	0.09.0	0.99
The Spanish Vare or Rod, four Palms)	3.004	3.00.0	
Their Foot is ⅓ of the Vare -	1.001	1.00.0	
Lisbon Vare -	2.750	2.09.0	1.06
Gibralter Vare -	2.760	2.09.1	1.03
Toledo Foot -	.899	0.10.7	1.00
Vare - -	2.685	2.08.2	
Italy.			
Roman Foot, on the Monum of Cossutius	.967	0.11.6	1.23
Of Statilius -	.972	0.11.7	
Roman Palm, for build- ing, whereof ten make the Cauna - -	.732	0.08.8	

	Thous. parts.	F. In.p.	Aver. 100 p.
Bononia Foot -	1,204	1,02.4	1.17
Ell	2,147	2,01.7	
Perch, whereof 500 to a Mile --	12,040	12,00 5	
Florence Brace or Ell	1,913	1,11.0	1.23
Naples Palm -	,861	0,09.6	1.43
Brace -	2,100	2,01.2	
Canna -	6,880	6,10.5	
Genua Palm -	,830	,09.6	1.41
Mantova Foot -	1,569	1,05.8	1.43
M lan Calamus -	6,541	6,26.5	1.40
Parma Cubit -	1,866	1,10.4	1.43
Venice Foot -	1,162	1,01.9	1.53

Other Places.

	Thous. parts.	F. In.p.	Aver. 100 p.
Dantzick Foot -	,944	0,11.3	1.19
Ell	1,903	1,10.8	
Copenhagen Foot -	,965	,11.6	0.94
Prague (in Bohemia) Foot -	1,026	1,00 3	1.06
Riga Foot -	1,831	1,09.9	
China Cubit -	1 016	1,00.2	
Turin Foot --	1,062	1,00.7	
Cairo Cubit -	1,824	1,09.9	1.61
Persian Arash -	3,197	3,02.3	
Turkish Pike, at Constantin. the greater	2,100	2,02.4	0.86
The Greek Foot -	1,007	1,00.1	
The Universal measure.	3,267	3, 3.2	

A *Pendulum* of the just length whereof will vibrate 60 times in a Minute.

A Table for guaging of Wine Casks which are not full.

G.	parts	G.	parts	s	parts	G.	parts	G.	parts
0	000	13	1630	25	4330	35	5913	52	7072
	295		2703		4400		5976		7758
1	470	14	2775	27	4462	40	6042	53	7822
	602		2847		4542		6094		7909
2	720	15	2918	28	4585	41	6158	54	7990
	830		2986		4646		6223		8072
3	935	16	3056	29	4726	42	6288	55	8154
	1038		3123		4766		6352		8236
4	1138	17	3189	30	4826	43	6418	56	8319
	1235		3255		4835		6483		8404
5	1329	18	3321	31	4943	44	6548	57	8491
	1422		3387		5000		6613		8580
6	1502	19	3452	32	5057	45	6679	58	8661
	1596		3517		5115		6745		8755
7	1681	20	3582	33	5174	46	6811	59	8862
	1764		3647		5234		6877		8961
8	1846	21	3712	34	5294	47	6944	60	9065
	1928		3777		5354		7012		9177
9	2010	22	3842	35	5415	48	7082	61	9280
	2091		3906		5476		7153		9398
10	2171	23	3960	36	5535	49	7225	62	9530
	2242		4024		5600		7297		9705
11	2328	24	4087	37	5662	50	7370	53	10000
	2405		4150		5724		7444		
12	2481	25	4213	38	5787	51	7519		
	2556		4270		5850		7595		

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A Table of Meridional Parts.

Deg L a.	0	10	20	30	40	50	D
0	0	16	38	50	66	88	16,5
1	100	116	133	150	166	183	16,5
2	200	216	233	250	267	283	16,5
3	300	317	333	350	367	283	17
4	400	417	433	450	467	484	17
5	500	517	534	551	567	554	17
6	601	618	634	651	668	685	17
7	701	718	735	752	769	785	17
8	802	819	836	853	870	887	17
9	903	920	937	954	971	988	17
10	1005	1022	1039	1056	1082	090	17
11	1107	1124	1141	1158	1175	1192	17
12	1209	1226	1243	1260	1277	294	17
13	1311	1328	1345	1367	1380	1397	17
14	1414	1431	1448	1465	1483	1500	17
15	1517	1534	1552	1569	1586	1604	17
16	1621	1638	1656	1673	1690	1708	17,5
17	1725	1743	1760	1778	1795	1813	17,5
18	1830	1848	1865	1883	1900	1918	17,5
19	1936	1953	1971	1988	2006	2024	17,5
20	2042	2059	2077	2098	2113	2131	17,5
21	2148	2166	2184	2202	2220	2238	18
22	2256	2274	2292	2310	2328	2346	18
23	2364	2382	2400	2419	2437	2455	18
24	2473	2491	2510	2528	2545	2565	18
25	2583	2601	2620	2638	2657	2675	18
26	2694	2712	2731	2750	2768	2787	18
27	2806	2824	2843	2862	2880	2899	18
28	2918	2937	2956	2975	2994	3013	19
29	3032	3051	3070	3089	3109	3128	19

A Table of Meridional Parts.

Deg.Lat.	0	10	20	30	40	50	D
30	3147	3166	3185	3205	3224	3244	19
31	3263	3282	3302	3322	3342	3361	19
32	3380	3400	3420	3439	3459	3479	20
33	3499	3519	3539	3559	3579	3599	20
34	3619	3639	3659	3679	3700	3720	20
35	3740	3760	3781	3801	3822	3842	20
36	3863	3884	3904	3925	3946	3967	21
37	3987	4008	4029	4050	4071	4092	21
38	4114	4135	4156	4177	4198	4220	21
39	4241	4263	4284	4306	4327	4349	22
40	4371	4393	4414	4436	4458	4480	22
41	4501	4524	4546	4569	4591	4613	22
42	4636	4658	4681	4703	4726	4749	22
43	4771	4794	4817	4840	4863	4886	23
44	4909	4932	4956	4979	5002	5026	23
45	5050	5073	5097	5120	5144	5168	23
46	5192	5216	5240	5265	5289	5313	24
47	5337	5362	5386	5411	5436	5461	25
48	5485	5510	5535	5560	5586	5611	25
49	5636	5662	5687	5713	5739	5764	26
50	5790	5816	5842	5868	5893	5921	26
51	5948	5974	6001	6027	6054	6081	26
52	6108	6135	6163	6190	6217	6245	27
53	6272	6300	6328	6356	6384	6412	28
54	6440	6469	6497	6526	6555	6584	29
55	6613	6642	6671	6700	6730	6760	29
56	6790	6820	6850	6879	6910	6940	30
57	6970	7002	7031	7060	7094	7125	31
58	7156	7188	7220	7252	7283	7316	32
59	7348	7380	7413	7446	7479	7512	33

°′	0	10	20	30	40	50	D
			A Table of Meridional Parts.				
60	7545	7579	7612	7646	7680	7714	34
61	7748	7793	7817	7852	7887	7923	35
62	7958	7994	8029	8065	8102	8138	36
63	8175	8211	8248	8286	8323	8361	37
64	8399	8437	8475	8514	8553	8592	38
65	8631	8671	8710	8750	8791	8831	39
66	8872	8913	8960	8996	9038	9080	41
67	9123	9166	9214	9252	9296	9340	43
68	9384	9429	9474	9517	9565	9611	45
69	9657	9704	9751	9798	9846	9899	47
70	9943	9991	10041	10091	10141	10192	49
71	10242	10294	10346	10398	10450	10504	52
72	10558	10612	10666	10722	10777	10834	54
73	10890	10948	11005	11064	11123	11182	57
74	11242	11303	11365	11427	11489	11553	61
75	11617	11684	11747	11814	11881	11948	67
76	12016	12086	12156	12227	12299	12371	70
77	12445	12519	12595	12671	12749	12828	74
78	12907	12988	13070	13153	13237	13322	81
79	13409	13497	13586	13677	13765	13863	88
80	13958	14055	14153	14253	14355	14459	97
81	14565	14672	14781	14893	15007	15123	107
82	15242	15363	15487	15613	15242	15874	121
83	16009	16148	16289	16435	16584	16737	139
84	16884	17056	17222	17194	17570	17752	162
85	17942	18135	18336	18548	18761	18986	
86	19220	19464	19719	19986	20266	20560	
87	20870	21197	21545	21915	22310	22585	
88	23193	23692	24238	24812	25517	26282	
89	27165	28210	29488	31137	33460	37431	
90	Infin.						

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